RAILROAD GAZETTE

FRIDAY, MARCH 25, 1904.

CONTENTS

ILLUSTRATED:

Improvements on the Denver & Rio Grande..... 224
Reconstruction of a Bridge on the Midland Railway, Across the River Trent..... 228
Location of the Knoxville, La Follette & Jellico R. R. 232
New Automatic Block Signals on Southern Pacific. 237
Hydraulic Lock on the Trent Canal at Peterborough 238
A New Rail Section..... 241
Standard Tunnel Section, Norfolk & Western..... 242

CONTRIBUTIONS:

Tonnage Rating on a Combined Car and Tonnage Basis 223
Self-Contained Electric Trains 223
Handling Compound Locomotives..... 223

EDITORIAL:

The Anthracite Coal Workers..... 234
Eminent Domain vs. Minority Stockholdings..... 234
February Accidents 235
Delaware & Hudson..... 235
Texas & Pacific 235
Editorial Notes 235
New Publications 236
Trade Catalogues 236

MISCELLANEOUS:

The Special Apprentice 223
An Analysis of the Value of Recent Improvements on the Union Pacific..... 226
Foreign Railroad Notes 226
Water Supply for Railroads..... 230
Engineering & Maintenance of Way Assn. Convention 231
Exhibits at the Maintenance of Way Convention.. 236
Steel in Car Construction..... 237
Reaming Structural Steel 240
Train Accidents in the United States in February.. 241
Water Softening 242
Performance of Automatic Block Signals Under Unfavorable Conditions 242
Electric Railroads in Ohio 243

GENERAL NEWS:

Technical 244
The Scrap Heap 245
Meetings and Announcements..... 245
Personal 245
Elections and Appointments 246
Locomotive Building 247
Car Building 247
Bridge Building 247
Railroad Construction 248
General Railroad News 248

Contributions

Tonnage Rating on a Combined Car and Tonnage Basis.

Cincinnati, O., March 5, 1904.

TO THE EDITOR OF THE RAILROAD GAZETTE:

It is now thoroughly understood that the variation in resistances per ton for cars of different weights is due in a large measure to the variation in the coefficient of journal friction for different journal pressures. Experiments on journal friction show that:

(*a*) With perfect lubrication the coefficient of friction varies inversely as the pressure, or the resistance for all pressures is constant.

(*b*) Perfect lubrication obtains when there is a floating bearing, no contact existing between journal and bearing; that is, the friction is in the lubricant itself. The coefficient of rolling friction also decreases as the pressure increases.

There is a certain fixed amount of resistance for each wheel and journal for all loadings. The resistance per ton for this amount varies inversely as the pressure, or rather the number of journals on which the load is placed. This means in effect that the resistance varies with the number of cars in which the load is placed.

These facts are essentially taken into consideration in the "adjusted tonnage" method of locomotive rating. However, there is an objection to this method in that it involves a fictitious tonnage, causing difficulties in compiling performances, and, too, it involves some labor on the part of men making up the tonnage allowance for trains. It is possible to apply these principles simply using only actual tonnage. This consists in tabulating the ratings corresponding to different numbers of cars. This does away with the multiplication involved in the "adjusted tonnage" method and has the advantage that actual tonnages are used. Then, too, the principles involved stand out so clearly that men connected with the work become more intimately acquainted with them which in itself is extremely valuable.

A table made up on this basis is as follows:

Tonnage Rating.

	Cars.						
Engine.	20	25	30	35	40	45	50
Class A.....	1,000	975	950	925	900	875	850
Class B.....	800	775	750	725	700	675	650
Class C.....	700	675	650	625	600	575	550

This table is made up by simply taking the highest and lowest rating for Class A and interpolating for the remainder of the ratings inversely as the number of cars. For the other two classes only the highest rating is taken or any intermediate one and the other ratings supplied by using the common difference as shown by Class A. The table can be carried to any refinement the service will warrant. By checking this table up by actual performances it can be made very accurate. For different temperatures or kinds of weather separate ratings can be made up, using different colored sheets or marking the separate tables plainly on one sheet. Engines in low condition kept in service can be bulletined, reducing the rating a certain per cent.

A. L. KUEHN.

Self-Contained Electric Trains.

Americus, Ga., March 14, 1904.

TO THE EDITOR OF THE RAILROAD GAZETTE:

As an interested reader of your able journal, among other things, I have been interested in the discussion of the question of the application of electric power to the present steam railroad systems. In all the discussions of the subject I have seen no account of experiments with a turbine-electric locomotive. There is no question that the steam turbine is the engine of highest thermal efficiency. It is impossible to apply it to the railroad locomotive directly because of its necessarily high speed and the difficulty of finding an efficient type of engine capable of being reversed. Why not design a locomotive utilizing its steam power by means of the turbine, converting that power into electricity and applying the power thus generated directly to the axles of engine and tender and perhaps some of the following train? Turbines and dynamos directly connected could be ranged alongside the boiler and would not be of greater size or weight than the cylinders, etc., of the present reciprocating engine. Among the advantages of such a motive power are the following:

1. Each train would be an independent unit, avoiding the evident disadvantage of the centralization of a railroad's motive power, which is necessary with the electric system as at present utilized, particularly in times of domestic disquiet or war.

2. A greater efficiency of the locomotive as a steam engine because of the use of turbine motors. More power can be secured from a given amount of steam.

3. Greater efficiency of the electric system because of the short length of the power transmission line, thus avoiding loss of power by better insulation, absence of leakage, and resistance from long lines of wire.

4. The reciprocating engine has its speed limit while the electric motor theoretically has no speed limit.

5. Greater tractive efficiency pound for pound of engine weight because the power can be applied with almost no friction to a greater number of wheels.

6. Such an application of electric power would avoid the constant menace to public safety of live wires and third rails, besides doing away entirely with the vast expense of the installation and maintenance of such lines of power transmission.

7. Instead of the abolition of a vast number of highly skilled locomotive engineers and the substitution of low-grade motormen, with a consequent economic loss to the community, the locomotive engineer would have to be more highly skilled and even better paid than now, with a consequent economic gain to the community.

I am no engineer, in fact I am only a Presbyterian minister who once studied engineering and still likes to read the *Railroad Gazette*. Perhaps if I were an engineer I would see difficulties in the way of carrying out my suggestion that I don't see now, but I believe the scheme will work and that as a compromise measure it will solve the tractive problem of the railroad of the future.

J. LOGAN IRVIN.

[In England a motor coach has been built having a gas-engine driven dynamo delivering current to motors on the axles. Thermodynamically and practically the gas engine for this purpose is more efficient than the steam turbine. Without the use of a condenser, the steam turbine is no more efficient than a good compound reciprocating engine and for practical reasons it is not well to use a condenser on a locomotive. Under these conditions the size of the boiler would be the same for the self-contained turbo-electric system above suggested, as for a compound steam locomotive, which means that additional space would have to be provided in the proposed system for non-condensing steam turbines capable of delivering from 1,000 to 2,000 horse-power. Even if the scheme were mechanically feasible it would probably work out that nothing could be saved in first cost over a central station electric system and certainly the maintenance charges would be very high. The general application of electricity to steam roads is no doubt dependent on the ultimate perfecting of alternating current systems in which the power is generated at central stations by high grade reciprocating engines, turbines or gas engines.—EDITOR.]

Handling Compound Locomotives.

Fort Madison, Iowa, Feb. 27, 1904.

TO THE EDITOR OF THE RAILROAD GAZETTE:

In your issue of November 20th Mr. J. V. N. Cheney criticizes my paper on "Care and Handling of the Compound Locomotive," read before the Traveling Engineers' convention last September, and while I have neither the time nor the inclination to enter into a long discussion with this gentleman, I do wish to correct a few statements made by him. Mr. Cheney apparently is not familiar with the valve setting of compound engines. If he were he would know that neither both high and low-pressure exhausts, nor cut-off in both cylinders, take place at the same time. His statement in regard to the high-pressure exhaust passing to the atmosphere is fully explained in my paper, as well as all other blows in this kind of an engine.

Crank-pin diagrams will show that the crank effort is more uniform on the compound than on the simple engine. It can also be said, as a general statement, that the greater the expansion the more uniform the crank effort. The test referred to by me was published in the *Railway Master Mechanic* for January, 1903, and I gave *my* opinion, which is the privilege of any man, that the compound would pull 100 tons more than the simple engine up a grade of 42 ft. a mile. I am aware that the manufacturers of compound engines do not agree with me in this assertion. The simple engine will handle half its rating more economically than the compound, one reason for which is that it can be worked in a shorter cut-off. As for the remark about "no one but a blankety blank idiot starting an engine with a train with the reverse lever other than in full stroke," any man who ever ran an engine, or has had charge of enginemen, knows this is done by the careless engineman, and I was reading a paper of instructions to men whose duty it is to instruct.

The reciprocating parts of a compound engine must be heavier than those of a simple engine, because of extra pistons, etc.; this should be plain to any man. Mr. Cheney thinks it a useless expense to examine packing rings. If I were to judge by what he says in regard to one particular road having to take a compound out of road service to use it as a switcher because of a broken relief-valve cage, I would say, by all means this is the one road where packing rings should be examined, as it is evident that those handling engines are not up to date. The periodical examination of packing rings is a matter of shop practice recommended by me in order to get best results. He also says that the Vauclain compound will slip worse than a simple engine, but this is due to "faulty design and low adhesion." I say nothing in regard to faults in the design, but will quote my remarks on this question: "In starting the train, and while it is being pulled over the road, we should be very careful not to let the engine slip any more than is absolutely necessary, as the four-cylinder compounds will wear their tires faster than a simple engine, owing to the fact that they will slip six revolutions where a simple engine will slip four, because the power that starts the engine to slipping has to pass through two cylinders instead of one, and after the engine starts to slip it requires but little crank effort to keep the wheels turning." Any engineer of any experience knows this is true, as an engine practically empties the dry pipe before it quits slipping. While defects in design will make an engine slip, the compounding of the steam will make this same engine slip more revolutions.

The compound will start a heavier train than the simple engine of the same class, which should be plain without an explanation, and it does not need the "slack" spoken of by Mr. Cheney. His remarks about the piston valve call for no comment from me, as I find no fault with the piston valve. Mr. Cheney says he does not wish to be considered an anti-compound man; when once familiar with this class of engine, he will have no cause to regret his decision. His suggestion in regard to oiling compounds by hand, using the oil pipes to supply a little steam going down hill is a grand idea (?), and I would suggest that he take the matter up with the locomotive builders, as I am satisfied they have overlooked this valuable point.

A. L. BEARDSLEY.

The Special Apprentice.

BY PROFESSOR W. F. M. GOSS.*

To the technical graduate the motive power and car departments of a railroad offer two alternatives. He may enter the drafting room either in the capacity of a draftsman or with the expectation of soon becoming one, or he may enter the service as a special apprentice. If the former, his course is the result of purely business propositions. He finds the work and the wage properly adjusted one to another, and there is nothing in the whole process which is peculiar or which in any wall calls for extended discussion. He is a workman, is recognized as such, and his opportunities for bettering his condition are subject to many of the limitations which apply to workmen.

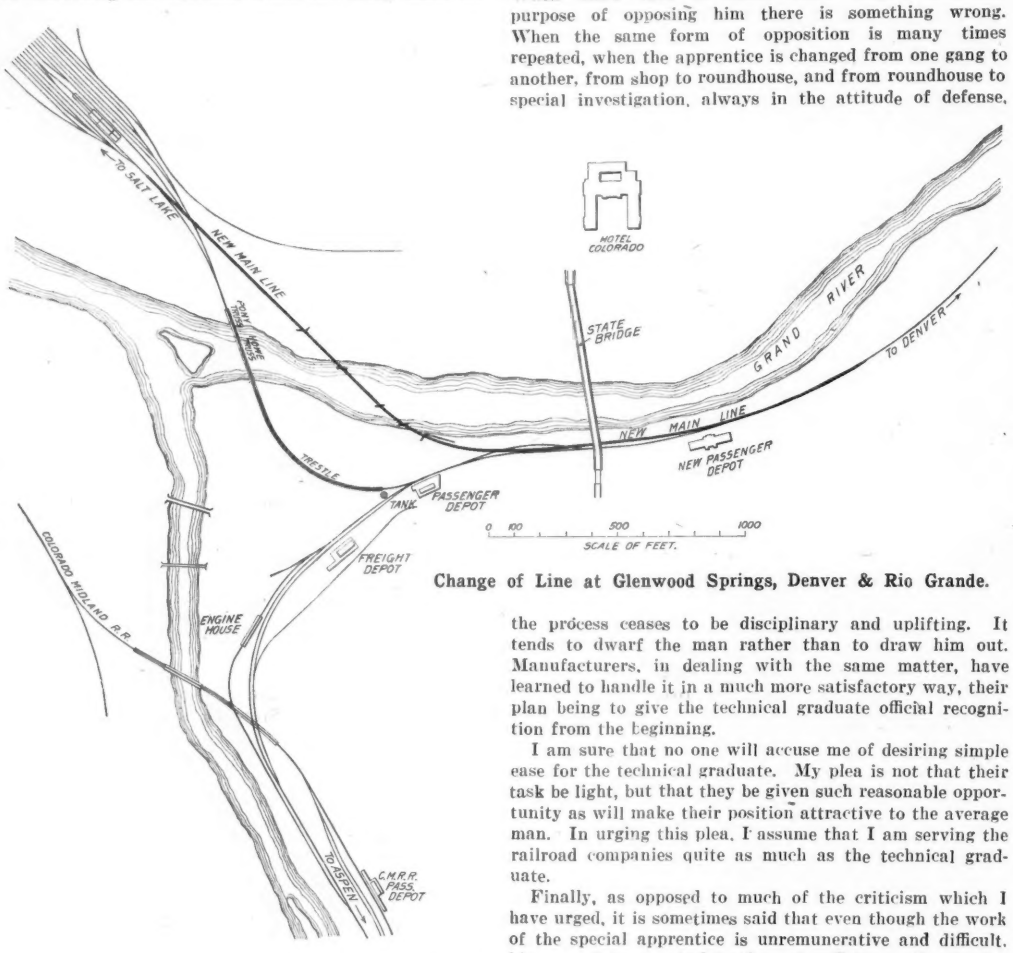
The technical graduate who enters upon a special apprenticeship, by so doing announces that he intends to work for an official position on the road; and the company in accepting him agrees to so train him that he may be worthy of such a position. In view of this compact, the special apprentice accepts a low wage, and the railroad company undertakes to vary his task notwithstanding the fact that such a course limits for a time the usefulness of the apprentice. On a very few large railroad systems the course for special apprenticeships has been worked out with care. Students in such courses are handled with intelligence and consideration, with the result that they are satisfied, while the road accomplishes its full purpose in training men for its service. Most roads, however, undertake to receive special apprentices with no adequate understanding of their responsibility in the matter. It often happens that injustice is done the special apprentice and that in the end the road fails in its efforts to make him a means of strengthening its organization. Moreover, the unhappy experiences of those who have been through the mill, or have attempted its passage, have had their influence on the undergraduate with the result that it is now

*Read before the Western Railway Club.

more difficult than formerly to interest graduates in a special apprenticeship. Such a condition is unnatural. It is unmerited by the technical graduate, and is, I am sure, contrary to the real interest and desire of the management of our railroads.

In view of this, I venture to outline some of the defects which, as they seem to me, sometimes appear in the administration of the special apprenticeship, and, in some cases, to suggest a possible remedy.

One defect is the low wage paid the special apprentice. He has depended upon others throughout his school and college course and has long looked forward to the time when he can begin to take care of himself. He is willing to deny himself many things; he will be content with rough clothes and scant fare, but except in rare cases, he must have self-support. This is not given him, as a special apprentice, and the opportunities of such an apprenticeship are, therefore, sealed against most graduates. It is only the man of means, or the man who is not very sensitive concerning the sacrifices which are being made for



Change of Line at Glenwood Springs, Denver & Rio Grande.

him at home, who can enter such a course. In effect, therefore, the railroad deliberately closes its doors to the rank and file of the graduates in mechanical engineering.

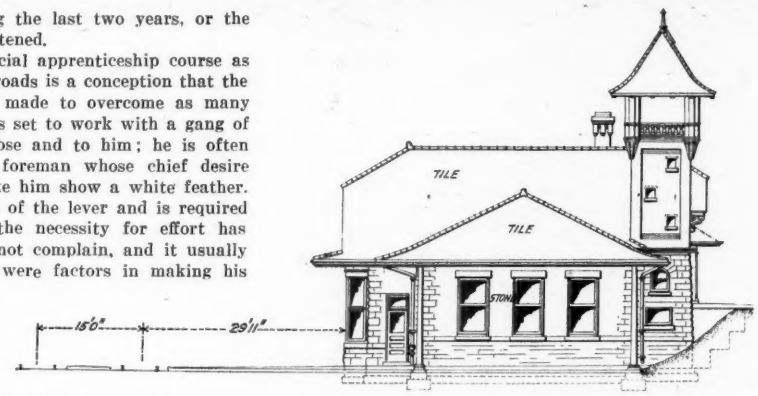
Some roads have fallen into the habit of receiving technical graduates, ranking them as special apprentices, and of then undertaking to see how valuable they can be made to the road, without much regard for the rights of the graduate. By this arrangement it is possible to secure a man for 12 or 14 cents an hour, who can run a lathe, make a drawing, summarize statistics, conduct an experimental investigation, inspect material, report on defective equipment, test a locomotive, figure the bracing for a boiler, outline a scheme for motor-driving in an existing shop, install motors, or interview a division superintendent in behalf of his chief. When a road keeps such a man busy under the hardest sort of conditions, perhaps transferring him to a roundhouse or division shop remote from the center of the road's activity, where he has no contact with men who can aid him and few opportunities to observe processes which can instruct, the attitude of the road toward him is lacking in that element of fairness which is essential to permanent success. An organization in which such things are possible is obviously not ready for a special apprenticeship. It needs more than other roads, perhaps, the technical graduate, but it has no right to accept him as a special apprentice. It ought rather to take its technical graduates as it takes other men, not for the purpose of training them, but for getting service from them, and having them, they should pay them what they earn. I am glad to say that there are some roads which are now following this latter plan.

Another defect in the present special apprentice course is the long continuance of a deadly parallel. By the present practice all men are treated, or at least paid, alike, usually throughout a three years' course. While I am a great believer in the buoyancy of youth, I know that it takes unusual qualities of character to inspire a man to unusual and long-continued effort when his companion who makes no such effort, receives the same recognition as himself. I recognize the fact that the difficulties which, in a railroad organization, arise with this objection are great. Nevertheless for best success the system must individualize the man before he reaches the age of 25. This the special apprenticeship fails to do. Either the rate of pay should be varied during the last two years, or the formal course should be shortened.

Again, underlying the special apprenticeship course as administered upon most railroads is a conception that the technical graduate must be made to overcome as many difficulties as possible. He is set to work with a gang of men unfriendly to his purpose and to him; he is often required to work under a foreman whose chief desire for the time being is to make him show a white feather. He is given the heaviest end of the lever and is required to keep lifting long after the necessity for effort has passed. As a rule, he does not complain, and it usually happens that the men who were factors in making his lot hard are among the first to start a song in his praise. But even though the process seems to work out successfully, it may not be wise. When one's task is made hard merely for the purpose of opposing him there is something wrong. When the same form of opposition is many times repeated, when the apprentice is changed from one gang to another, from shop to roundhouse, and from roundhouse to special investigation, always in the attitude of defense, the process ceases to be disciplinary and uplifting. It tends to dwarf the man rather than to draw him out. Manufacturers, in dealing with the same matter, have learned to handle it in a much more satisfactory way, their plan being to give the technical graduate official recognition from the beginning.

I am sure that no one will accuse me of desiring simple ease for the technical graduate. My plea is not that their task be light, but that they be given such reasonable opportunity as will make their position attractive to the average man. In urging this plea, I assume that I am serving the railroad companies quite as much as the technical graduate.

Finally, as opposed to much of the criticism which I have urged, it is sometimes said that even though the work of the special apprentice is unremunerative and difficult, his reward is sure and in the end sufficient. But is this true? I know that popular sentiment or fancy lends a halo of brightness to the official position of the railroad, but the time has long since passed when sentiment could be made an important factor in a business contract. Is it true that the degree of official recognition which awaits the average technical graduate in the railroad service is greater than that which awaits him in the service of corporations of other sorts, and if it is not true, is it good policy on the part of the railroad corporation to make its early work less attractive than that of other corporations?



End Elevation of New Passenger Station.

Improvements on the Denver & Rio Grande.

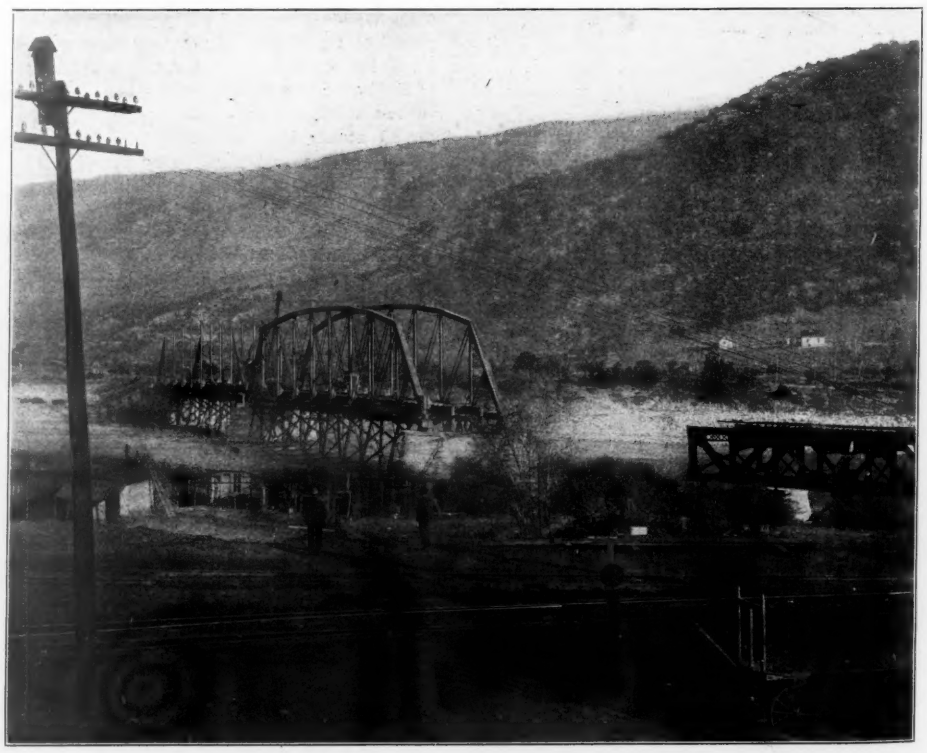
During 1903 some 45 miles of grading and new track work was done on the Denver & Rio Grande, 10 miles of which was additional main track made necessary by line changes, and 20 miles being required in the construction of the Salina Canon extension or cut-off, grading for which was done in 1902. The principal grade reduction, elimination of curvature, re-location, completing of second track, etc., is briefly described in the following:

Raise of Grade at Buttes.—Buttes is about midway between Pueblo and Colorado Springs, and the work at this point consisted principally in raising the grade at the crossing of the Fountain River to provide increased waterway. This crossing had always been a source of considerable annoyance during the cloudburst season in the summer months. The original span of 110 ft. and the piling approaches at the west end were replaced by a new 165-ft. through span on concrete masonry. The total length of line affected was about two miles.

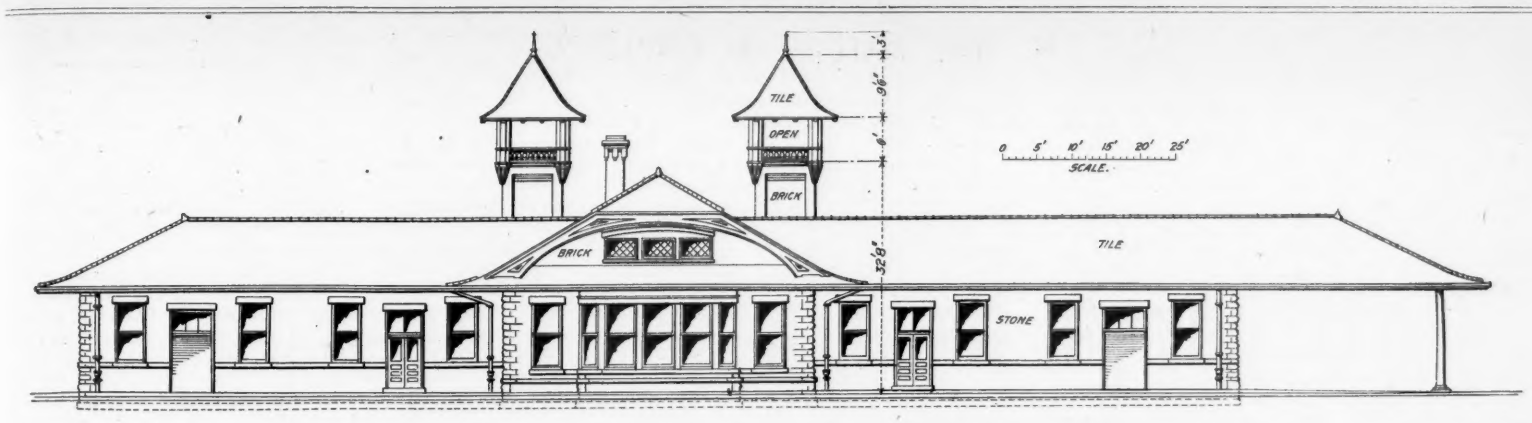
Joy-Goodnight Change.—The principal object of this change was to provide an extension of the double track from Joy west to Goodnight, just west of Pueblo. The sharper curves were reduced, but the total curvature and the grade, which is light, were unchanged. The bridges on the old line consisted of two pile-trestle bridges, 32 ft. and 80 ft. long, respectively. On the new line these were replaced by concrete culverts, the larger being a triple-arch design of 15-ft. spans, with 3-ft. rise. The total length of this change was about 2½ miles.

Minturn Line Relocation.—Minturn is 26 miles north of Leadville and the change, which is some 3.1 miles long, reduced the degree of curvature from 10 to 6 deg., and the maximum grade from 3 per cent. to about 1.75 per cent. A second main track was built the length of the change, and all temporary openings were rebuilt with permanent structures of masonry and steel.

Nathrop-Buena Vista Line Change.—The line of the Denver & Rio Grande follows the Arkansas River all the way from Pueblo to Leadville. Buena Vista is 36 miles south of Leadville and Nathrop is seven miles further south. The old line runs along the south bank of the river and is quite crooked, the total curvature being



View from Old Station at Glenwood Springs, Showing New Truss Bridge During Erection.



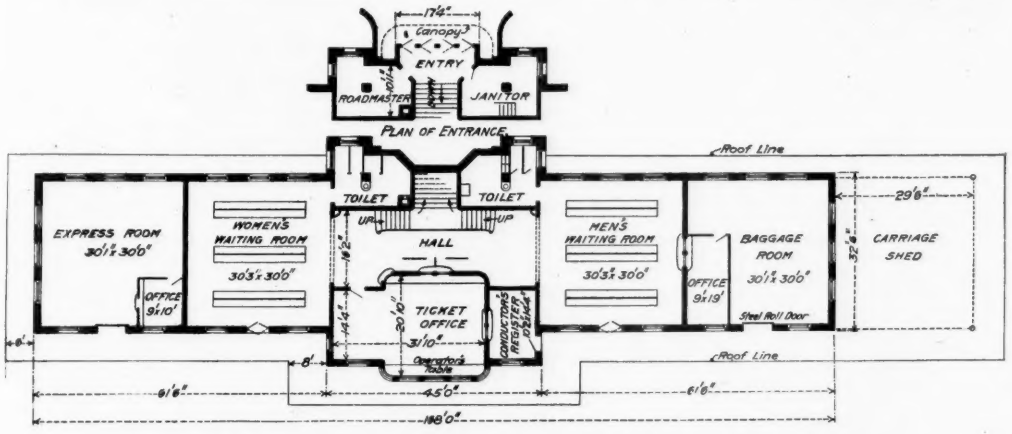
Track Side Elevation of New Passenger Station at Glenwood Springs, Denver & Rio Grande.

446 deg. 42 min., and the maximum curve 12 deg. The new line is practically a tangent between Nathrop and Buena Vista, having maximum curves of 30 min. and a total curvature of 35 deg. 10 min. The total length of line was reduced 1,900 ft.

The new line, the grading for which was generally lighter than the old one, except at the river crossings, involved two long crossings of the Arkansas River, which the old line was built to avoid. The two bridges are identical in design, each being a deck, pin-connected span, 146 ft. center to center of end piers, resting on concrete abutments. The two crossings required about 10,000 yds. of masonry and 1,200,000 lbs. of metal work in their construction. A construction view of one of the bridges, the one nearest Nathrop, is shown. It will be observed that the falsework is only partly completed. The stream is quite swift and is subject to rapid fluctuations of two or three feet by reason of water being taken from the Twin Lakes reservoirs for irrigation purposes. It was therefore not safe to place the falsework until the steel work was ready to put up to hold it in place.

Glenwood Springs Line Improvement.—This work is now in progress and is perhaps the most important of any of the changes described. The town, which is about 125 miles directly west of Denver and 84 miles by rail from Leadville, is much frequented by tourists who go there to bathe in the natural hot springs, the waters of which contain large amounts of sulphur and salt. The drinking water is also said to have medicinal properties.

From the map of the town and of the line changes, it will be seen that the railroad enters the town from the east along the south bank of the Grand River, which it follows to the west side of the town, and then crosses on an old wooden Howe truss bridge with pile trestle approach. This structure consists of two 150-ft. through-truss spans and one 48-ft. half-through span, with 650 ft. of pile trestle approach, on a heavy curve. The Aspen branch of the road comes in at this point, the passenger station being located at the junction of the two lines.



Floor Plan of New Passenger Station at Glenwood Springs, Denver & Rio Grande.

The increased tourist business has severely taxed the existing station accommodations, requiring an enlargement; also it was necessary to replace the old wooden bridge and trestle approach on account of their condition and unfitness to carry the heavy loading. It was therefore decided to change the line, producing the tangent through the yards from the west, across the river and connecting with the tangent from the east by an 8-deg. 30-min. curve. This change will reduce the total curvature from 135 deg. to 85 deg. and the maximum curve from 12 deg. 30 min. to 8 deg. 30 min., and the length of line some 300 ft. A new passenger station is being built about 1,000 ft. east of the old one, in the heart of the town, as will be seen from the map.

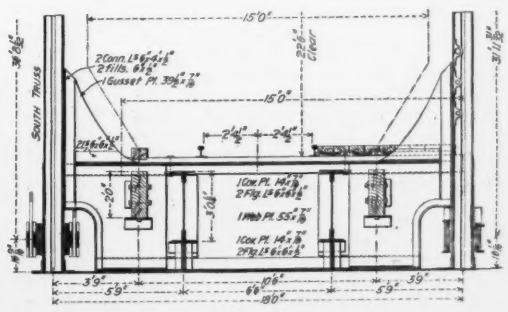
The new crossing of the Grand River consists of two through spans, 213 ft. 4½ in. center to center of end pins, and two pin-connected deck spans, one 120 ft. and the other 108 ft. long, all being skew spans. The piers and abutments are concrete, the average height being about 20 ft. above the bottom of the river, and the average depth 10 ft. below. The bottom at this point consists of large boulders, intermingled in places with a formation from the hot springs in the neighborhood. In order to do the work economically it was necessary to execute the excavation and masonry work during the winter season, when the water is lowest; for though at this point the river has a range of only five or six feet between high and low water, the current is quite swift. There were some 3,700 yds. of bridge masonry, the mixture being 1 part cement, 3 of sand and 6 of stone and gravel, the sand, stone and gravel all being obtained on the site.

The through spans of the superstructure have a skew of 37 deg. 12 min. and the width, center to center of trusses, is 18 ft., with a clear width of 15 ft. The depth, center to center of chords, is 40 ft., and the vertical clearance is 23 ft. The deck spans are skewed for a curve of 8 deg. 30 min., and are 12 ft. center to center of trusses. The illustrations show some interesting erection views of this structure. This bridge, and in fact all steel bridges on the system, is designed in accordance with the specifications of the Pennsylvania Lines West of Pittsburg, their class A loading being used in determining stresses.

The two parts of the town on opposite sides of the river are connected by State Bridge, which may be seen in one of the erection views. This is a double-deck structure, the lower level being a footbridge. The improvements include a subway entrance to the latter under the tracks, details of which are shown. The Aspen track is to be brought up to the new station, so that with a passing track there will be three tracks at this point. The material of the subway is concrete, reinforced overhead by 65-lb. rails, of which there are 82 pieces, 8 ft. 6 in. long. All details are shown clearly by the drawings.

The new passenger station, now about half finished, will be an unusually attractive building, the style of architecture and material of construction harmonizing well with its natural surroundings. It is a one-story structure of stone, with tile roof and two towers flanking the entrance. It is 168 ft. long, 32 ft. 6 in. wide at the ends and 48 ft. 9 in. wide at the center. At the west end the roof is extended beyond the west wall, resting on cast-iron columns 29 ft. 6 in. out from the wall, and forming a shed under which carriages may discharge and receive passengers. The foundations are concrete. The stone for the main body of the walls is a cherry-red color, while that for sills, lintels, quoins and trimmings is gray. The walls are coursed ashlar below the tops of the window sills and broken-range ashlar above. The courses below the window sills are alternately 5 in. and 12 in. high. The outside walls of the main building above the roof cornice, the towers above the belt course and the chimney above the roof line are faced with cherry-red pressed brick.

Erecting Grand River Bridge at Glenwood Springs, Denver & Rio Grande.
(Old Howe Truss Wooden Bridge on the Left.)



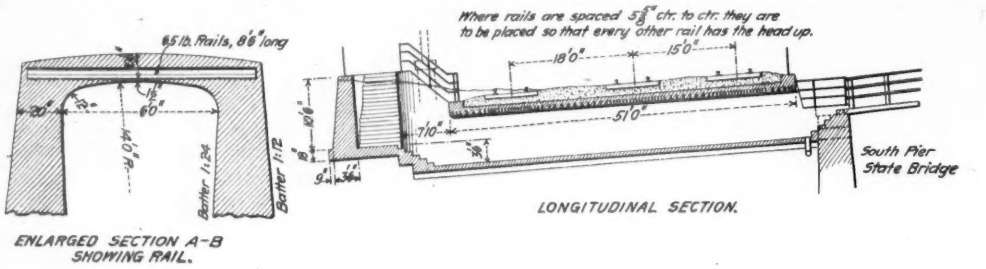
Detail of Bridge Floor, Glenwood Springs Bridge.

The woodwork in the hall, waiting rooms, ticket office, toilet rooms and entry, including treads and risers of stairway, is quarter-sawed oak, except the top floors in the hall, waiting rooms and ticket office, which are finished in

maple. The finish in all other rooms is white pine. All walls and ceilings, except the walls in the express and baggage rooms, which are red pressed brick, are plastered. The floors of the toilet rooms and of the express and baggage rooms, are granitoid, and on the track side each of the latter has a Kinnear steel rolling door. The building will be heated by steam and lighted by electricity.

The walks around the building will be granitoid. It will be observed that the street grades at the building site are such that the station floor is about 8 ft. 8 in. below the street level at the entrance. The granitoid walk from the street leads into a vestibule, from which a stairway leads down to a platform in the hall. Stairs on each end of the platform descend to the hall level. Retaining walls are built on each side of the entrance walk and the grounds in front of the station will be suitably terraced and sodded.

The bridge masonry construction work was done by company forces, all of this work being in direct charge of Mr. F. B. Clark, Superintendent of Bridges and Buildings. The improvements described are under the supervision of Mr. E. J. Yard, Chief Engineer, and Mr. W. A. Morey, Engineer Bridges and Buildings. We are indebted to Mr. Morey for data and information.



Subway Under State Bridge at Glenwood Springs.

Foreign Railroad Notes.

The officials in charge of the investigation of the disastrous accident on the Paris underground railroad last August have taken six months to decide that certain employees were negligent and are to be tried for causing death and injury by their negligence. A superintendent, an engineman, two conductors and a station man are to be prosecuted.

The little Nuremberg & Fürth Railroad, the first built in Germany, still maintains its independence and takes itself seriously. Last year its gross earnings were about $75,000 and its net income $3,621; yet the latter sufficed for a 5 per cent. dividend and an addition of $31.60 to the road renewal fund. From which we may assume that there is not much water in its stock ($72,700), which, indeed, is less than one-sixth of the value of its property.

Few things mark the difference between the Russian and the American farming communities more than the small amount of live-stock carried on the Russian railroads. In 1901 on something like 25,000 miles, 1,142,200 cattle and 673,000 hogs were carried. With the railroads so far apart, doubtless many more are driven to market there than here; but the difference in the number raised and consumed remains very great. For instance, St. Petersburg, with 1,300,000 inhabitants, received only 280,900 head of cattle.

An official Russian journal announces that hereafter the Government will not grant charters for railroads to be built by corporations with a Government guarantee of interest on their cost. Substantially all the railroads in Russia built by companies so far have had such guarantees, and the announcement now is looked upon as putting an end for the time to all railroad building except what is done by the Government itself. The guarantee system is almost sure to be abused. With a good rate of interest it makes it for the interest of the company to make their railroad as costly as possible, and when the net earnings fall far below the guaranteed interest it has no interest in increasing them at all unless it can increase them enough to exceed the guarantee.

Until a few years ago, the street railroads in the larger towns of Germany, and also in other countries of Europe, were divided into sections, often about a mile and a half long, and a fare was collected for each section, as on most of the longer country electric roads here. The ordinary fare for a section in Germany was 10 pfennige = 2⅜ cents. In Berlin a few years ago, and as it appears in many other German cities, the sections were abandoned and the 10 pfennige fare was accepted for all distances on any one line. Now it is said that this has been in many cases disastrous. About Berlin it has prevented the extension of the railroads in the outlying districts, and in some smaller places the companies are having very unsatisfactory returns and are trying to sell their lines to the municipalities.

An Analysis of the Value of Recent Improvements on the Union Pacific.*

BY J. B. BERRY, *Chief Engineer.*

When the present owners of the Union Pacific took over the property on Jan. 1, 1898, it was decided that extensive improvements should be made in order to put the road in condition for more economical operation. After a thorough examination of the existing conditions, a general policy was agreed upon which has since been carried out, and for which the management has made liberal appropriations. The proposed improvements included increase in size and power of locomotives and capacity of cars, reduction of ruling gradients and elimination of as much rise and fall, curvature and distance as was practicable. These improvements were to extend over all the main line, but owing to the peculiar conditions existing at the Wyoming Division, Cheyenne to Ogden, a distance of 516 miles, the most radical changes were made there.

A careful study was made of the maps and profiles of the constructed line and the records of earlier surveys and explorations in the territory under consideration, and engineers were placed in the field to re-run some of the old lines and make additional surveys. It was found that by doing some very heavy work a ruling gradient of .82 per cent., or 43.3 ft. per mile, could be established on the Wyoming Division, with the exception of two places where helper grades would have to be retained. These places were: Cheyenne to Buford, a distance of 27 miles westbound, and Ogden to Wahsatch, 65 miles eastbound, the latter stretch lying mostly in Weber and Echo Canons and having grades varying from 53 to 96 ft. per mile. On this section, however, the grades and alinement were susceptible of considerable improvement. The reduction of the ruling gradients was considered the most important object to be attained in the relocation of the line, saving in distance next, reduction of total degrees of curvature third, and saving in rise and fall fourth. In addition to the more important work of reducing maximum grades, lowering main summits and avoiding the wide detours made by the old line, much attention was devoted to minor changes which would take out curvature or other features unfavorable to a high speed line.

The following table shows in a general way what was done up to the end of the fiscal year ending June 30, 1902, on the first four engine districts of the division:

Comparative Summary of Physical Characteristics, Union Pacific.

	Cheyenne to Laramie.	Laramie to Rawlins.	Rawlins to Green River.	Green River to Evanston.	Total.
Length of district in miles—					
Before change	56.53	136.44	135.63	110.29	438.89
After change	56.90	116.99	134.16	100.08	408.13
Miles of new line built in making change.	29.63	59.12	43.84	34.73	167.32
Max. gradient, compensated—					
Eastbound, before change	97.7	58.0	70.2	67.0	....
After change	43.3	43.3	43.3	43.3	....
Westbound, before change	88.0	75.3	67.6	68.6	....
After change	82.0	43.3	43.3	43.3	....
Inc. in total curv....	86	...	...	...	....
Dec. in total curv...	...	4668	739	1847	7168
Dec. in rise and fall, ft. 162		128	77	265	632

A study of the operating statistics of this district for the two years ending June 30, 1900, as compared with the year ending June 30, 1902, shows that after the change, one more passenger train each way a day was run and the average number of freight trains each way a day increased on the section between Cheyenne and Laramie from 6.66 to 7.52. The increase on the other sections of the line in this district was not so great. Helper engine mileage in actual assistance of freight trains was reduced on the Cheyenne-Laramie section from 369 miles per 1,000 freight train miles to 180 miles, and for the entire division between Cheyenne and Evanston from 1,249 miles to 220 miles.

The reductions in gradient, distance, etc., given in the table show only the more important changes in the line; other minor changes which were made in connection with the revision of grades and not included in the table would increase the saving somewhat. On the district west of Evanston, much improvement work has been done especially in the canon between Wahsatch and Ogden, where a large amount of dangerous curvature has been eliminated and grades materially reduced. On the Cheyenne to

Erecting Deck Span Over the Arkansas River on Nathrop-Buena Vista Cut-Off.

*Abstract of a paper presented at the meeting of the American Railway Engineering and Maintenance of Way Association, Chicago, March 15-17.

Laramie district which crosses the summit of the Rocky Mountains, the summit was lowered 236 ft., the eastbound grade reduced to the adopted maximum of 43.3 ft. per mile, and the westbound helper grade reduced from 88 ft. to 82 ft. per mile and shortened about six miles. This was done with an increase of distance of only 0.37 miles and 36 deg. additional curvature. The increase in the number of trains run is due to increase in the volume of traffic; the average weight of train behind engine has been greatly increased, owing partly to reduction of grade and partly to the increase in the power of the locomotives used and higher capacity cars.

To those unfamiliar with the character of the country, it might appear that the great saving in distance and reduction of grade since made, stands as a criticism of the work of the pioneer engineers who made the original location of the road. Such is not the case. The changes that have been made have been expensive and could be warranted only by the increased volume of traffic handled at the present time. Too much credit cannot be given to Gen. G. M. Dodge and his assistants. They studied their task thoroughly and performed it well. Limited by law to a maximum gradient of 116 ft. per mile, not compensated for curvature, they held it down to about 90 ft. per mile. Taking into consideration the existing conditions of 35 years ago, lack of maps of the country, hostile Indians, making necessary escorts of United States troops for the protection of surveying parties, difficult transportation, excessive cost of labor, uncertainty as to probable volume of traffic, limited amount of money and the necessity of building the road as soon as possible, it can only be said with fairness that the line was located with very great skill.

In order to determine the relative merits of different locations, values must be ascertained for each detail affecting operating expenses. These details may be divided under four heads, gradients, distance, curvature and rise and fall. As the effect of each on operating expenses varies most directly with the number of trains run, the "train mile" is used as the unit or basis of calculation. The first step in the calculation is to determine the average proportion of each item of operating expenses to the whole expense. An itemized table showing the average of these proportions for the Union Pacific for the four years ending June 30, 1902, contains some interesting figures. Maintenance of way and structures cost 20.07 per cent.; maintenance of equipment, 20.55 per cent., which includes 10.19 per cent. for renewals and repairs to locomotives, 1.03 per cent. for shop machinery and tools, and 5.32 per cent. for repairs to freight cars; conducting transportation cost 49.36 per cent., including 10.10 per cent. for wages of engine and roundhouse men, 5.55 per cent. for wages of train crews, and 10.80 per cent. for fuel; taxes paid amounted to 5.69 per cent. and general expenses 4.38 per cent. The average cost per train mile for the four years was $1.17. A. M. Wellington, in his book, "Economic Theory of Railway Location," discusses fully the reasons for adopting certain of the percentages for separate and indeterminate items in such a table. Some percentages, different from those obtained by him, were deduced or assumed in making this investigation owing to certain conditions prevailing on the Union Pacific which differed from those existing on the roads considered by Wellington. The following explanatory notes give some of the reasons for assuming the values as given:

Maintenance of Way.—Total side track mileage is about 34 per cent. of the main track mileage. One-half of the side track is in large yards and terminals, the balance being side tracks at intermediate stations. About one-third as much labor is expended on repairs to side tracks as on the same length of main line and the same is true for material. In the calculations the distribution of labor and material for repairs to roadbed and track is assumed as follows: main track, 90 per cent.; large yards and terminals, 5 per cent.; smaller stations, 5 per cent.

Maintenance of Equipment.—The total train mileage on the Union Pacific is but 75 per cent. of the engine mileage. The distribution of contributing causes for repairs of engines of all classes is: time and exposure, 7 per cent.; stopping and starting, 12.68 per cent.; getting up steam and terminal work, 27.07 per cent.; average curvature, 2.07 per cent.; average grades, 12.96 per cent.; distance, 37.69 per cent. For passenger cars the distribution of repairs is: time and exposure, 11 per cent.; stopping and starting, 20 per cent.; switching, 11 per cent.; curvature, 2 per cent.; grades, 20 per cent.; distance, 36 per cent. For freight cars the corresponding percentages are respectively 6, 20, 16, 2, 20 and 36. These are based on an average curvature of 17 deg. per mile, whereas Wellington assumed 30 deg. per mile.

Conducting Transportation.—As only 75 per cent. of engine mileage enters into total train mileage, the wages of engine and roundhouse men charged against hauling trains are assumed as 75 per cent. of the whole. In train service, only about 75 per cent. of the crews are paid on a mileage basis, the balance being on a monthly basis, and any increase of distance, unless it be great, would affect only 75 per cent. of this item.

GRADIENTS.

The ruling grade of an engine district governs the number of trains necessary to handle the traffic of that district and should never be exceeded except where the character of the country is such as to make "helper grades" advisable. Any change that may be made in a line to reduce the ruling gradient will reduce the number of trains required to handle a given traffic. To get at the value of changes in ruling gradient the additional cost of running one more train per day to handle a given traffic must first be found. As many items in the detailed list of operating expenses are not affected by the addition of one train on the road and as others are affected only in part, the cost of running the additional train one mile will not be so great as the average cost per train mile for the entire traffic. On the Union Pacific it amounts to but 43.29 per cent. of the average cost per train mile, or $0.50. Adding interest on the additional locomotive and caboose required per train mile brings the cost up to $0.51. The saving per year due to the reduction of gradient so that one less daily train in each direction can handle a given traffic will be as follows: $0.51 × twice the length of engine district × 365. Multiplying this product by the number of round-trip daily trains saved and dividing by the interest rate will give the justifiable expenditure to make the proposed reduction of gradient. In order to find the number of freight trains saved by any reduction of grade it is first necessary to know the total train load that can be hauled on different gradients by a given standard engine. The standard Union Pacific consolidations having a tractive effort of 35,268 lbs., can haul 2,352 tons up a .4 per cent. grade, 1,190 tons up a 1 per cent. grade, and 599 tons up a 2 per cent. grade, assuming velocity and frictional resistance at 6 lbs. per ton. No advantage except a reduction of time would be gained by reducing grade below 0.4 per cent., since the starting resistance of the train on the level would limit its weight.

Helper Grades.—The greatest efficiency of helper engines is secured when the helper is kept constantly at work. To secure this efficiency the helper grade should be as nearly continuous and uniform as possible. The rise of the grade should be such as to require the full power of the helper engine in addition to that of the regular engine to handle the maximum train that can be hauled by an engine over the balance of the district. This reduces the length of the necessary helper grade and consequently the helper engine mileage.

For two engines of the same class the combined theoretical tractive power would be double what an engine would exert, but in practice it is not safe to assume this. A conservative estimate would be that only 90 per cent. of the tractive power can be available in the helper engine. This cannot be wholly applied to lifting the train load, as part of it is required for overcoming resistance due to the weight of the locomotive. The following table is a fairly accurate statement showing ruling gradient for one engine and equivalent helper grade for same train and same class helper engine, assuming 90 per cent. of tractive power for the helper engine and a velocity resistance of 5 lbs. per ton of train, equivalent to 12 miles an hour sustained speed for maximum train:

Ruling gradient, 1 engine.....	0.50	0.60	0.70	0.80	0.90	1.00
Equivalent gradient, 1 helper..	1.09	1.25	1.41	1.58	1.73	1.89

The cost of helper engine service for a fairly busy division is about 33.52 per cent. of the average cost of a train mile for the whole district. On the Union Pacific it amounts to $0.402 per engine mile. The cost per helper engine mile per year is $0.402 × 365 = $146.73, and as the engine must return light, the cost of helper service per train mile assisted train per annum is $146.73 × 2 = $293.46. If the cost of a helper engine mile be multiplied by the yearly engine mileage and the product divided by the interest rate, the justifiable expenditure to reduce the helper grade can be obtained. Where it is not advisable or economical to reduce a helper grade to the proposed ruling gradient for single engine, the line and grades on both sides should be adjusted so that when the business justifies the change it can be made without rebuilding any more than the portion where the helper grade is located.

DISTANCE.

The various items in the detailed analysis of operating expenses are not affected equally by changes in the length of line. Changes in distance can be divided into three classes: (*a*) Distances so short as not to affect train wages. (*b*) Distances affecting train wages but not so great as to affect the number of stations or sidings required. (*c*) Distances so great as to affect the number of stations and sidings required. The additional cost per train mile of changes under class A would be 32.10 per cent.; class B, 45.94 per cent.; class C, 59.05 per cent., or on the basis of an average cost per train mile of $1.17, the money values are respectively $0.3756, $0.5375 and $0.6909. The additional cost per annum per daily train one way would be for class A, $\frac{0.3756 \times 365}{5280} = \$0.026$ for each additional foot of distance; for class B, $0.5375 × 365 = $196.19 for each mile of distance, and for class C, $0.6909 × 365 = $252.18 for each additional mile.

CURVATURE.

No logical value can be placed on the elimination of a single curve where the total degrees of curvature are not reduced. Only the value of reducing the total curvature can be considered. Average train resistance can be safely assumed as about 10 pounds or the equivalent of 28 miles per hour on a level tangent. Curvature on the Union Pacific is compensated at 0.04 ft. per degree of curvature (equivalent to 0.8 lbs. per ton of train.) The resistance on a 12 deg. 30 min. curve would be 10 lbs. per ton, hence on a 12 deg. 30 min. curve with level track, the resistance would be twice the average. The additional cost per train mile due to one mile of 12 deg. 30 min. curve (total angle of 660 deg.) would be 35.35 per cent. Where curvature is compensated for grade, the increase in fuel, water, etc., would be eliminated, making the increased cost for curvature in one mile 29.88 per cent. Reducing these to a money value on a basis of $1.17 per train mile gives $0.4136 for uncompensated curvature and $0.3496 for compensated curvature. The costs per degree of total curvature per daily train per year is $\frac{0.4136 \times 365}{660} = \$0.23$ for uncompensated curves and $\frac{0.3496 \times 365}{660} = \$0.193$ for compensated curves.

RISE AND FALL.

Rise and fall may be divided into three classes. Class A includes all cases where grades are so light or so short as not to require the use of brakes or variation in the working of the engine. Class B includes all cases where grades are such as to require shutting off steam in descending but are not long enough to require application of brakes to prevent exceeding the maximum safe speed. Class C includes all cases where grades are so steep as to necessitate not only shutting off steam, but the application of brakes in descending. To get at the true class a virtual profile should be worked up for each line, but for estimating purposes the following limits are fairly accurate: Class A, all rise and fall up to 30 ft. This class of rise and fall adds so little to the operating expenses that it need not be considered in comparing values of lines. Class B, all rise and fall of over 30 ft. on grades of less than 0.6 per cent., since the maximum velocity that can be attained on a 0.6 per cent. grade by a train dropping of its own weight is about 32 m. p. h. At this velocity the train resistance equals the force of gravity. Owing to the fact that curves may be located near the bottom of grades, the maximum safe speed should not be taken at more than 30 m. p. h. Class C, all rise and fall on grades of 0.6 and over where the total drop exceeds the drop required to accelerate trains from 10 m. p. h. up to 30 m. p. h.

The average resistance of a train is about 10 lbs. per ton, equivalent to a speed of 28 m. p. h., and the resistance due to grade on a 0.5 per cent. grade is 10 lbs. per ton. Therefore the total resistance on a mile of 0.5 per cent. grade is double the resistance on a mile of level tangent. To get at the value of rise and fall it will be assumed that there are two miles of tangent, the first mile having an ascending grade of 0.5 per cent. and the second mile a descending grade of the same rate, the two miles containing 26.4 ft. of rise and fall. The additional cost of operating per train mile for class B is 3.38 per cent., and for class C, 7.13 per cent. The money value of these percentages on a basis of $1.17 per train mile, average, is for class B $0.0395, and for class C $0.0834. If the rise and fall is on gradients equal to or greater than the ruling gradient, 3 cents per train mile should be added to the above figures for wear and tear on rolling stock and track, making class B 6.95 cents, and class C 11.34 cents per train mile.

The additional cost per annum of one foot rise and fall per daily train, one way, is for minor grades: Class B, $\frac{.0395 \times 365}{26.4} = \$0.55$. Class C: $\frac{0834 \times 365}{26.4} = \$1.15$. On ruling grades: Class B; $\frac{.0695 \times 365}{26.4} = \$0.96$. Class C; $\frac{.1134 \times 365}{26.4} = \$1.57$. Multiplying the above costs per foot rise and fall by the total number of trains in each direction and dividing by the interest rate will give the justifiable expenditure to eliminate one foot of rise and fall. Class A drops are practically harmless except when emergencies arise requiring the checking of speed, in which case they would prove expensive.

The theory of velocity grades, train resistance, tractive power of locomotives and maximum train loads are discussed briefly by the author to explain some of the assumptions made in the foregoing calculations.

SUMMARY.

Gradients.—A reduction of gradient on an engine district 100 miles long so as to require one less daily train in each direction will result in a saving of $37,230 per year. For other lengths of district or a greater reduction in the required number of trains, the saving in operating expenses per year will be in direct proportion to this. Any reduction in length of helper grades or other change that will eliminate one helper engine of the same size as the standard road engine will result in a saving of $14,673 per year, providing that the helper engines average 100 miles per day. For other average daily mileage of helper engine the saving is in direct proportion to this.

Distance.—A saving in distance will result in the following savings per year per daily train one way:

Class A.—Distances so short as not to affect wages of engine or trainmen, 2.6 cents per foot, or $137 per mile.

Class B.—Distances affecting train wages, but not affecting the number of side tracks required, 3.7 cents per foot, or $196 per mile.

Class C.—Distances so great as to affect the number of side tracks required, 4.8 cents per foot, or $252 per mile.

Curvature.—The elimination of degrees of total curvature will result in a saving per year per daily train one way of 23 cents per degree for uncompensated curvature and 19 1/2 cents per degree for compensated curvature.

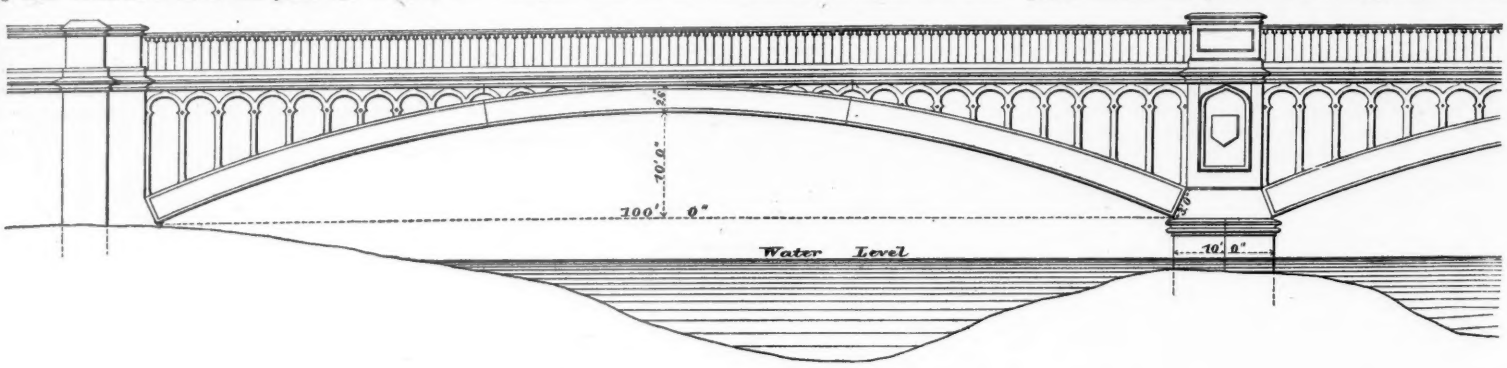
Rise and Fall.—The elimination of one foot of rise and fall will result in a saving per year per daily train one way as follows: Class B, where grades are such as to require shutting off steam in descending but not to require the application of brakes on minor grades, 55 cents per foot and on ruling grades, 96 cents per foot. Class C, where grades are such as to require the application of brakes on minor grades, $1.15 per foot and on ruling grades $1.57 per foot.

These values are sufficiently close for the locating engineer to use in comparing the various proposed lines. A final and more careful comparison should be made in the office of the Chief Engineer.

Reconstruction of a Bridge on the Midland Railway, Across the River Trent.*

BY FRANK HORACE FRERE, *Assoc. M. Inst., C. E.*

The bridge referred to carries the passenger trains of the Midland Railway main line over the River Trent, and is about 20 miles north of Leicester. It consists of three openings, each of 100 ft. span, with arched viaduct approaches, built of brickwork, to allow easy passage of flood-water. The bridge stands almost due north and south, and is built on the tangent. The Midland at this point consists of four tracks, two additional tracks having been constructed about ten years ago to carry the heavy freight and mineral traffic. The bridge for these lines was constructed on the east or down-stream side of the original bridge and about 30 yards distant from it. In the space thus provided between the two bridges the spans for the new bridge were erected, on staging.



ELEVATION OF SPAN OF OLD BRIDGE.

Fig. 1.

For the purposes of the reconstruction, the passenger traffic was turned temporarily on to the freight tracks. This was done by inserting a connection between the passenger and freight tracks a little to the south of Redhill Tunnel, and another at the north end of the Trent Viaduct. The distance traveled by passenger trains on the freight tracks was about half a mile.

The Old Bridge.—The old bridge was built for the Midland Counties Railway in 1839, under the direction of Mr. Vignoles, Engineer of that company. The superstructure was entirely of cast-iron, and was made and erected by the Butterley Company, of Derby. It consisted of three arches, each of 100 ft. span and 10 ft. rise, resting on masonry abutments and on two masonry piers in the river, the arches springing about 4 ft. above normal water level from heavy cast-iron skewbacks, backed with masonry (Fig. 1). Each span consisted of six cast-iron ribs, viz., two outside ribs, more ornate than the others, carrying the parapet, etc., and four inside ribs spaced under the four rails. The ribs were made up of three castings, each about 34 ft. long, namely, two spandrel pieces and a middle or key piece. Each rib consisted of a horizontal top girder of H section, 8 in. wide x 12 in. deep, of 1½-in. metal (Fig. 2) connected, in the case of the spandrel pieces, to the main arch rib by verticals bifurcated at the top, 8 in. x 3 in. in cross-section and spaced 3 ft. 6 in. apart. The main arch-rib was also of H section, 8 in. wide, 2 ft. 6 in. deep at the crown, and 3 ft. deep at the springing, with 3 in. thickness of metal in the flanges and 2 in. in the web. The spandrel pieces which measured 15 ft. deep over all at the springing end and 6 ft. at the shallow end, by 34 ft. long, were, as already stated, in one casting, and weighed 22,400 lbs. apiece in the case of the inside ribs, and 25,760 lbs. in the case of the outside ribs; the middle or key-pieces of the ribs weighed 17,360 lbs. apiece, thus making the total weight of one of the inside ribs 62,160 lbs. The main arch-ribs were braced together, at the two joints, by heavy distance pieces, bolted through the ribs, forming the covers for the joints, and also by three other intermediate and lighter distance pieces. The joints in the top girder were secured by cotters and pins. Resting on the top of these ribs was a timber decking consisting of 4-in. creosoted planking on which the ballast was laid. The total weight of the cast-iron in the original bridge was approximately 733 tons.

In 1881 cast-iron distance pieces between the top girders, additional cast-iron distance pieces between the main arch ribs, and a considerable amount of wrought iron cross bracing and diagonal bracing were introduced to strengthen the bridge, and again in 1893 additional wrought-iron cross bracing was added, to tie the four inner main arch ribs more firmly together.

For some years past the stability of the old bridge had caused considerable anxiety, owing partly to the vibration caused by the heavy rolling loads and also to a slight rocking movement of the piers due to the uneven loading of the arch, which was noticed when the rolling load was at one end of a span only, the adjoining span not being loaded at the time. When, in 1902, it was decided to employ locomotives of 123 tons weight, it was thought the time had come to replace a bridge which had been designed when the heaviest locomotive weighed only some 39 tons. Accordingly, in February, 1902, a contract was let for the removal of the old bridge and the building of a new one in its place. It was decided to raise the old masonry abutments and piers, and to replace the cast-iron ribs by a steel superstructure similar to that adopted for the freight track bridge alongside, which would ensure the load coming in a truly vertical direction on to the piers. One of the principal considerations was, that the time during which the traffic over the old bridge had to be discontinued should be as short as possible, and for this purpose it was decided to have the new spans erected and ready to be pulled into their permanent position before diverting the passenger traffic.

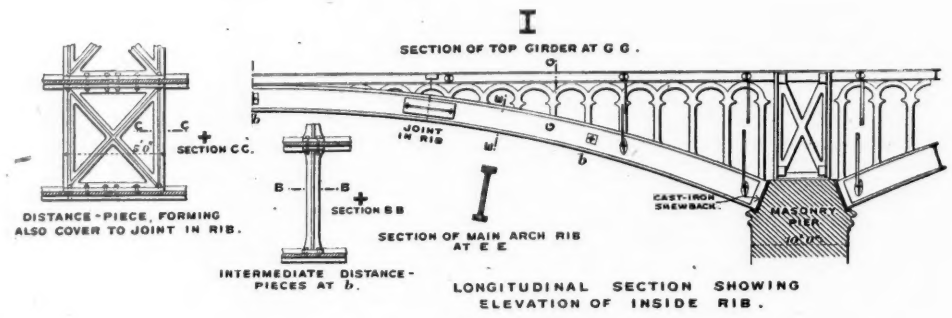

I
SECTION OF TOP GIRDER AT G G.
JOINT IN RIB
SECTION C C.
DISTANCE-PIECE, FORMING ALSO COVER TO JOINT IN RIB.
SECTION B B
SECTION OF MAIN ARCH RIB AT E E
CAST-IRON SKEWBACK.
MASONRY PIER
INTERMEDIATE DISTANCE-PIECES AT b.
LONGITUDINAL SECTION SHOWING ELEVATION OF INSIDE RIB.

Fig. 2.

Method of Taking Down and Removing the Old Bridge.—As soon as the traffic had been diverted on to the freight tracks, the northbound passenger track over the bridge was removed, the ballast being loaded up and taken away, and the southbound track was slewed into the center of the bridge. The parapet was next taken off throughout. As a preliminary, piles were then driven into the bed of the river, under the ends of the spandrel pieces (Fig. 6), one pile in the center of the bridge and one at either side, just inside the outside rib, making six piles in all to each span. When driven, these piles were sawn off, and a cap sill was fitted close up to the under side of the ribs. This was done to take the weight of the ends of the spandrel pieces of the ribs when the middle piece should be removed. The south span was attacked first; the timber decking was sawn off close to the outside ribs, which, being then free, were removed by means of a steam crane working on the line of rails left across the bridge, starting with the middle piece in each case. The rails across this span, and also the decking, were then removed. A floating crane, made of a derrick crane capable of lifting 10 tons, fixed on to two 30-ton barges securely braced together so as to distribute the load, was employed to take out the middle pieces of the four inner ribs, the south spandrel pieces of these ribs being removed by a steam crane working over the south abutment. The outside ribs of the center span were next dealt with by a crane working on the line of rails over the bridge, as already described, and this crane was then employed to remove the four north spandrel pieces of the south span. As soon as this had been done the rails across the center span were pulled out and the decking removed; the middle pieces of the four inside ribs of this span, and afterwards the south spandrel pieces of these ribs, were then taken out by means of the 10-ton floating crane. This process was repeated with the north span until only the four north spandrel pieces of that span remained, and these were taken out by a steam crane working over the north abutment. As soon as the floating crane had taken out a piece of the bridge, it was pulled towards the portion of the bridge still standing, and the piece was taken hold of by a 12-ton crane working on the top, and thus removed. The parts were first broken up and then loaded into wagons and disposed of as scrap. The bridge when taken down was found to be in very good condition, and had not suffered in any way from rust or corrosion during its 63 years of existence. Very little difficulty was experienced in getting the pieces apart, but hydraulic jacks were used in every case to start the joints when removing the middle piece of a rib. The time occupied in pulling down the bridge was 43 working days, but the speed was considerably improved toward the end, the last span being pulled down in 10 working days.

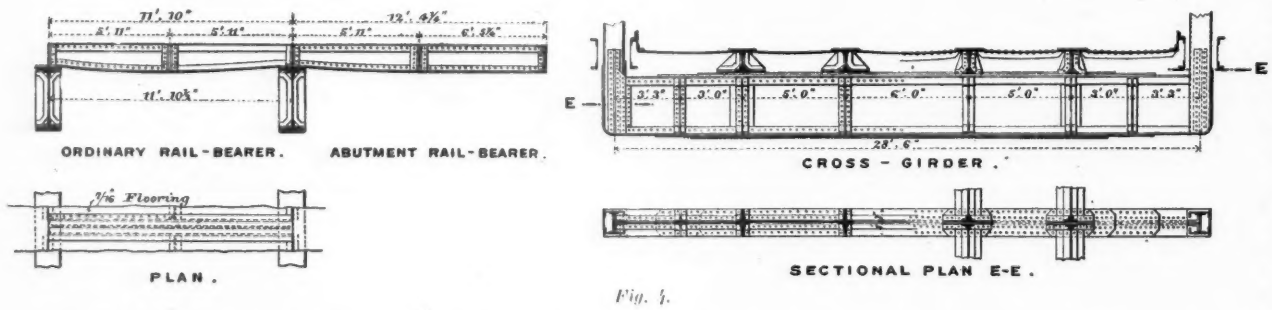


Fig. 4.

The New Bridge.—The new bridge is built entirely of steel, and consists of lattice girders, of the type known as the "Linville truss," having raking ends, the girders being 109 ft. 10½ in. long and 13 ft. 3 in. deep over all, spaced 28 ft. 6 in. apart, center to center, with overhead bracing at three points in each span (Fig. 3). The vertical members run through, and extend 3 ft. below the bottom chord, which has no horizontal bottom plate. To these verticals are attached the cross girders in such a manner as to bring the load as nearly as possible on to the center of the vertical. (Fig. 4.) The stringers under each rail rest on the top of the cross girders, and carry the floor plates, which are dished to drain the water to the center of each plate, where there is a row of drain pipes to let off the water. The flooring is covered all over with asphalt, 1 in. thick, and upon this the ties and rails are laid and ballasted with broken granite. At the ends of the main girders are cast-iron rocker plates bearing on 2 in. steel bed plates fixed on the top of stiff sill girders 35 ft. long and 3 ft. deep, which distribute the load as much as possible over the masonry of the abutments and piers.

Staging for Erection of Girders, Etc.—For the purposes of erection, a timber staging was built in the space between the old bridge and the freight bridge extending 230 ft. on the north shore, and carried forward across the river, with a gap of 80 ft. in the center (Fig. 6). Upon this staging, which was about 6 ft. 6 in. above normal water level, rails were laid to take the trolleys on which the main girders were erected. The staging on the shore, which was wide enough for the erection of the main girders, consisted of verticals resting on sills, with cap sills on top, carrying longitudinals to which the rails were spiked. For the length across the river, piles were driven in with cap sills fixed to them, and between these piles, longitudinally, were trussed timber beams, capable of removal if necessary in case of excessive flood. Oppo-

*Reprinted from the Proceedings of the Institution of Civil Engineers, Vol. CLIV, part IV.

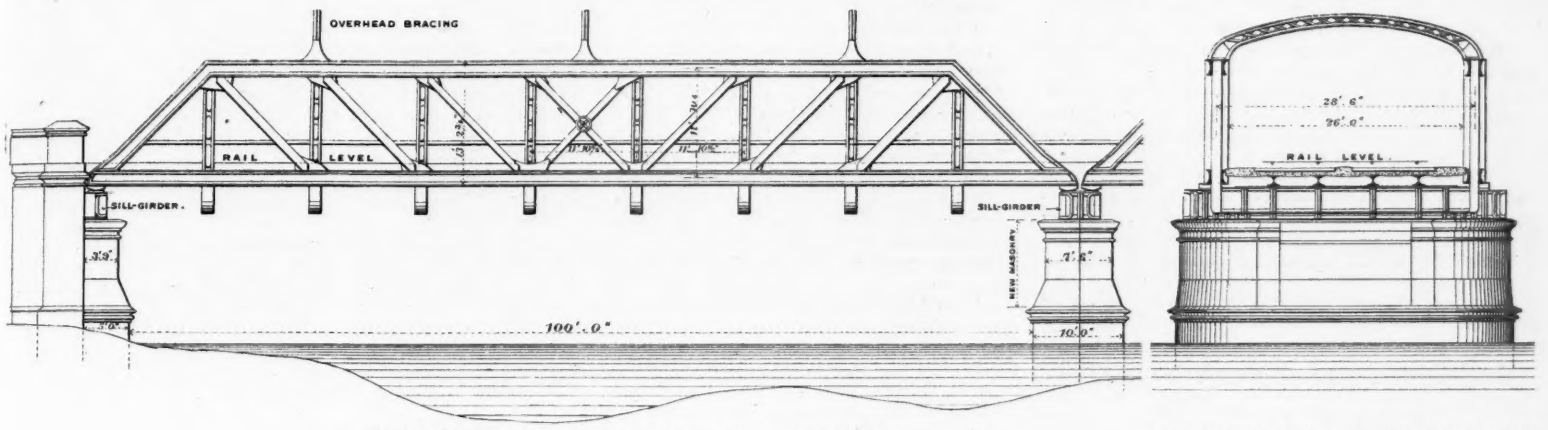


Fig. 3.

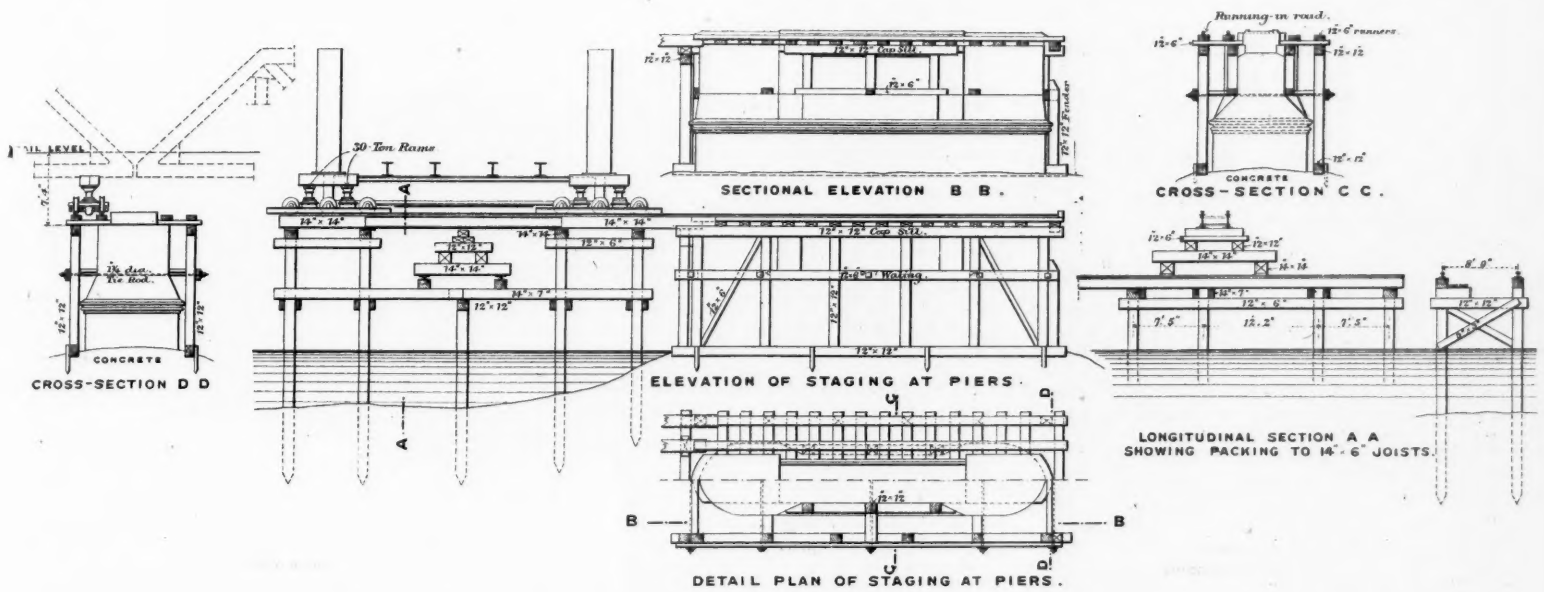
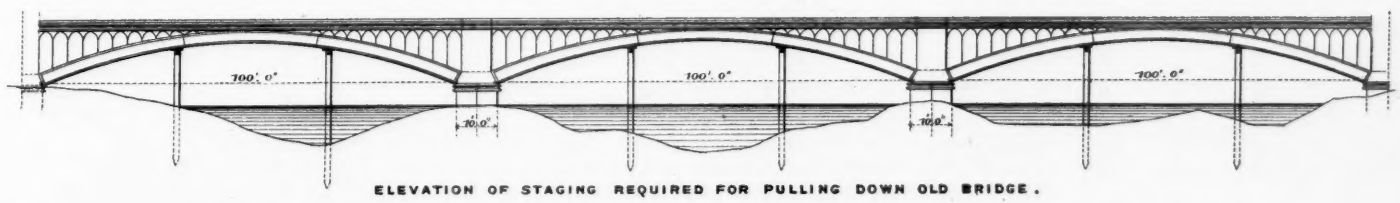
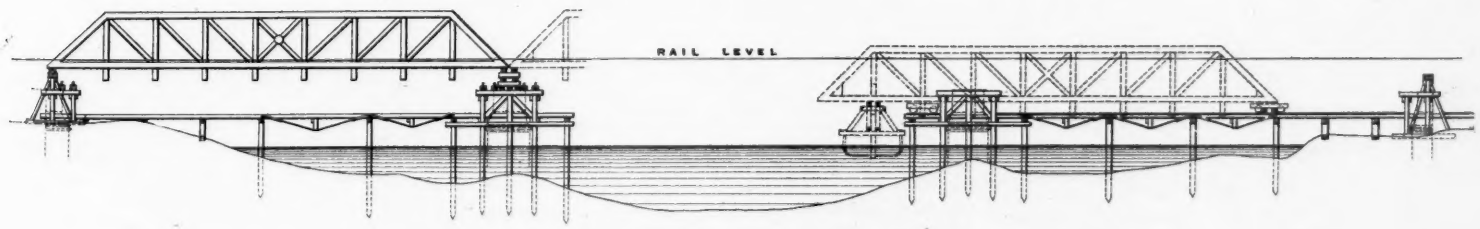


Fig. 5.





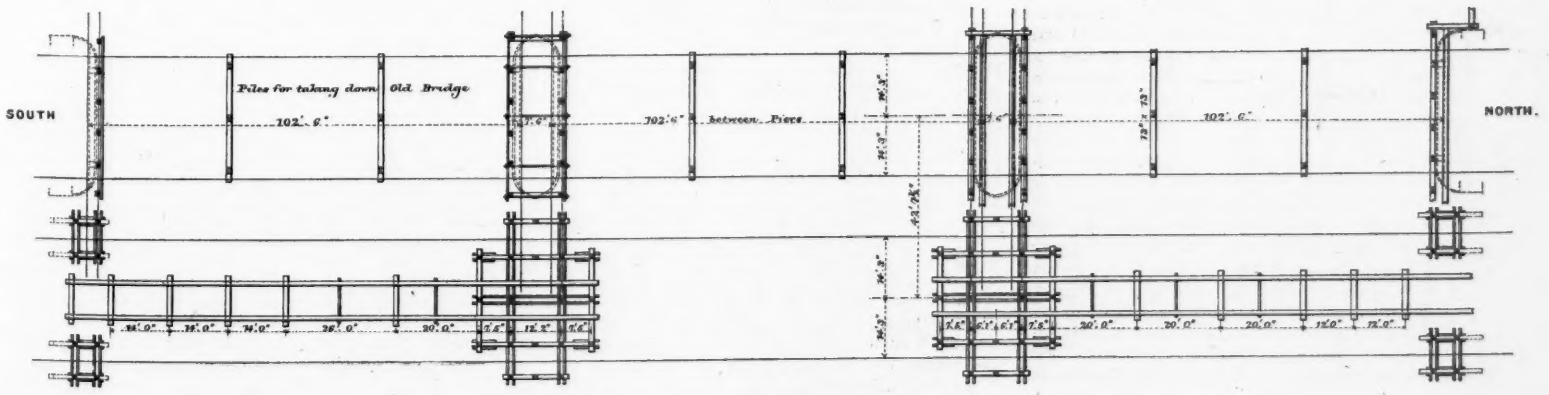


Fig. 6.

Midland Railway Bridge Over River Trent.

site the abutments and piers, on either side of the staging and at right angles to it, additional staging, carried on piles and strongly braced, was erected, at about the finished level of the bridge, and on this the complete spans were erected and riveted. The gap over the lower staging was bridged across with steel joists, packed at the center of the lower staging (Fig. 5). This higher staging was extended in front of the piers and abutments by means of props resting on a sill bedded on concrete at the foot of the piers, and was also propped away from the existing masonry of the piers, etc., and tied together with long bolts through the masonry. On the top of this staging was laid a pair of rails on which ran the trolleys used to pull the spans into their permanent positions on the piers and abutments. A stage was erected on the south shore, just beyond the staging for the end of the south span, and on this was built a 5-ton derrick crane, fitted with four double-flanged wheels running on rails; this crane was used to erect the cross girders and flooring.

The Erection of the Steelwork.—A temporary siding off the freight line was laid near the north shore for the delivery of the materials for the bridge. The main girders were shipped in sections and were erected on the north shore on the staging already described, which was long enough to take two girders, end to end. These were put together on blocking in the ordinary way, except that the ends of the girders rested on trolleys running on rails on the top of the staging. As soon as the southernmost girder of the two, "A," was riveted, it was run forward on to the staging over the river, and the other girder, "B," being partly riveted, was run forward into "A's" place, and a third girder, "C," was erected in "B's" place, and so on. In this way all the six girders were erected and riveted, and as each was completed it was taken along the staging, across the river to its proper position, the two girders of the south span being put together first, and those for the north span last. When the girders, in being drawn forward, came to the gap in the lower staging, they had to be "barged" across. This was done in the following manner: The trolley under the leading end of the girder was kept far enough back to allow that end of the girder to project beyond the staging, and a barge, on which was timber blocking sufficiently high to take the weight of this end of the girder, was brought under it. The leading trolley was then removed, and the girder was drawn forward, the front end resting on the barge, and the back end on the trolley on the staging behind (Fig. 6). On arriving at the farther side of the gap the front end of the girder was lowered on to a trolley on the staging on that side, and the barge was released and taken back, the process being repeated to bring the back end of the girder across. In the case of the girders for the middle span, of course, only the leading end of the girder had to be "barged" across, while the girders for the north span were run into their proper position on the staging, no "barging" being necessary. As soon as the ends of the girders were in position opposite the staging at the piers or abutments, the girders were lifted by means of 50-ton hydraulic jacks, on to trolleys running on the "running-in" rails, and spread sideways, one girder to the west and the other to the east. The girders were then carefully set parallel to each other and at the proper distance apart, to allow of the erection of the cross girders, and were made secure on timber blocking. Especial care had to be taken during the process of drawing forward, jacking up and spreading the girders, to prevent their tilting over sideways, and careful strutting and staying was necessary.

When the main girders for the south span were in position on the higher staging, the erection of the cross-girders, stringers, etc., was commenced. These were brought to the site in barges, and were lifted out of the barges and into position by the 5-ton derrick crane which had been put together on the staging on the south shore. When a few of the cross girders, with their stringers and plate flooring, had been put together and bolted, longitudinal timbers were laid upon them and on these the rails for the 5-ton derrick crane were carried forward on to the span; as the erection of the flooring proceeded, the crane was gradually traveled forward over it. As soon as the flooring became clear behind the crane, the riveting was started and was proceeded with as the crane moved forward. In this procession from span to span the cross girders and flooring for all three spans were erected and riveted up until the north span had been completed, when the crane was taken to pieces and removed. When the riveting was sufficiently advanced a start was made with the painting of the steelwork, and last of all the flooring was asphalted over; the cast-iron rocker plates were fixed to the underside of the main girders, and the span was then ready to be pulled sideways over the piers and abutments, into its permanent position. All the riveting at the site was done by Boyer pneumatic long-stroke riveting hammers, with the exception of a small amount which was done by a pneumatic gap machine. The compressed air for working the riveting hammers, pneumatic holders-up and rivet forges, as well as for working pneumatic drills, augers, etc., when required, was supplied by a 30-h. p. Marshall portable engine, driving an Ingersoll-Sergeant air-compressor, which maintained a working pressure of 80 lbs. per sq. in. and was capable of working six pneumatic tools.

Masonry.—The existing masonry of the abutments and piers of the old bridge had to be raised 9 ft. to bring it up to the necessary height to take the sill girders (Fig. 3). The erection of the new masonry followed as closely as possible the pulling down of the old bridge, as much of the existing masonry as necessary being pulled out to make way for the new. The new masonry for the abutments was fixed by a derrick crane, erected on the shore, and of sufficient jib radius to take the stones out of the boat in which they were brought and fix them the whole length of the abutment. The bedstones were fixed by a crane working on the road above the abutment. The new masonry for the piers was fixed by a 3-ton floating crane, the stones being taken to it in boats. The large bedstones on the piers, weighing 7 tons each, as well as all the intermediate bedstones, were fixed by a derrick erected on the staging alongside the piers. All the new masonry was built in cement, and in a very solid manner.

Pulling the Spans Into Position.—As soon as the bedstones on the south abutment and the south pier were fixed the higher staging, on which the completed spans were standing, was continued in front of the abutments and piers, as already described, and the rails for the trolleys bearing the span were then laid and spiked to the longitudinals on the top of the staging. These trolleys consisted of a framing made up of small steel joists resting on six double-flanged wheels, and carrying a pair of hydraulic rams, each capable of lifting 30 tons. On these rams was placed timber blocking to carry the girders. Four trolleys were used for "running-in" a span, one trolley under the end of each girder. All the rams on the trolleys at one end of a span were connected by pipes to a hydraulic press working on a small stage fixed on to one of the trolleys, and connected in such a way as to make it possible to raise or lower either pair of rams at will by means of cocks.

The south span was pulled into position first, and this was accomplished by means of crabs, fixed on the shore and on a stage at the end of the pier, in such a way as to get as straight a pull as possible. The span, having been first jacked up and the blocking removed, so that it rested on the trolleys, was then pulled a distance of about 42 ft. sideways, which occupied, on an average, about 60 minutes. As soon as the south span was over its final position the south end was lowered on to its bearings on the sill girder, which had previously been erected on the south abutment, with the steel bearing plates affixed, and the north end was lowered on to blocking. A temporary road was laid down the center of the new span and along this road the sill girder for the pier was brought and lowered, by a 12-ton crane, into its position on the pier; the blocking was then removed from under the north end of the span and it was lowered down on to the bearing plates on the sill girder.

The center span was dealt with in a similar manner; but in the case of the north span no temporary road was required, as the sill girder on the north abutment had already been placed in position by a crane working above that abutment. As soon as two of the new spans were in their final position the tracks were laid and ballasted, to forward the work as much as possible, and on the north span being got into position the tracks were run forward and joined up.

The erection of the main girders was commenced in July, 1902. The passenger traffic was diverted on to the freight tracks on Sept. 28, by which time the south span had been completed, the girders for the middle span were in position on the staging ready to receive the girders and flooring, and the girders for the north span were put together and riveted up. The new bridge was opened for traffic on January 11, 1903, a period of 15 weeks, which, having regard to the amount of work to be done, and the shortness of the winter days, was considered satisfactory.

The following are the weights of the steel-work in the bridge:

	Short tons.
Total weight of steel-work in the new bridge.....	698
Total weight in one span complete.....	219.5
Weight of one main girder.....	54.8

Before opening the bridge for passenger traffic it was tested with four of the heaviest locomotives, two on each track, coupled end to end; the total weight of these locomotives was 461.4 tons. With this rolling load, the main girders showed a deflection of ½ in. and the cross girders a deflection of ⅛ in.

The work was carried out from designs prepared by Mr. J. A. McDonald, M. Inst. C. E., Chief Engineer of the Midland Railway Company. The contractors for carrying out the whole of the work were Messrs. Handyside & Co., of Derby, Messrs. Chas. Baker & Sons, of Sheffield, doing the masonry work for them. The author was resident engineer in charge of the reconstruction.

Water Supply for Railroads.*

The water used in railroad boilers is practically limited to that found in the territory in which the railroads are located and the quality of the water depends largely upon the character of the geological formations with which it comes in contact. There are four distinct classes of water used by American railroads for making steam, namely: (1) natural soft water, (2) hard water, (3) alkali water, (4) corrosive water.

The impurities arising from the use of these various kinds of boiler water may be classified as follows: (1) Scale-forming impurities; (2) non-scale-forming impurities; (3) corrosive impurities. Of these the first and third classes cause most of the trouble with water in boilers. The impurities of these two classes can be removed from the water before it is put into boilers by proper treatment with chemicals. In most localities the principal trouble is due to the carbonates and sulphates of lime and magnesia that are in solution, causing the water to be hard. To precipitate lime and magnesia carbonates from hard water it is only necessary to remove from the water the carbonic acid gas that holds them in solution. Common slaked lime is the cheapest known chemical that will do this and not leave any by-product in the water. To precipitate lime and magnesia sulphates from hard water it is necessary to decompose them. Carbonate of soda, commercially known as soda ash, is the cheapest known chemical that will do this. It leaves dissolved in the water as a by-product sulphate of soda. This does not form scale. The process of water-softening may be divided into two parts, namely: (1) Mixing with the hard water the proper quantity of slaked lime required to precipitate the carbonates of lime and magnesia and also the proper quantity of soda ash required to decompose the sulphates of lime and magnesia. The hardening matter is thus taken out of solution but left in suspension. (2) Separating the matter in suspension from the softened water. The process, therefore, is a mechanical as well as a chemical one.

There are two general types of water-softening plants, namely, the intermittent type and the continuous type. In the intermittent type the hard water is mixed with the proper quantity of chemicals and the mixture allowed to stand in one or more large tanks or reservoirs until the solid hardening matter that is thrown out of solution by the chemicals has settled. The clear softened water above the precipitated solid matter is then drawn off, generally through a suction pipe attached to a float, and used at once or stored in a supply tank. When after some weeks it becomes necessary to remove the precipitated solid matter from the tanks or reservoirs, it is diluted with hard water and allowed to run out through a hole in the bottom. In the continuous type the top of the apparatus is located above the top of the supply tank. The hard water and chemicals are mixed at the top of the apparatus and then passed through one or more chambers that are provided with plates or other devices designed to collect the precipitated solid matter and deliver it at the bottom of the apparatus, from whence it is discharged daily. The soft water generally passes finally through a filter and is discharged into a supply tank. The cost of a water-softening plant set up ready for use varies from, say, $2,000 to $10,000, or more, depending largely upon the type of plant, its capacity and local conditions. The principal item of expense of softening water is for chemicals. The item of labor is small, because the little extra labor required—such as weighing out the chemicals—is usually done by the regular pumper. The amount of chemicals required varies according to the quantity of lime and magnesia compounds that are to be removed from the hard water. The character of these compounds also affects the cost. If the hardness is due to carbonates such hardness is removed by the use of slaked lime alone, and the cost, therefore, is much lower than if the hardness is partly or wholly due to sulphates, which are removed by the use of soda ash. The average cost for chemicals required to soften the railroad water supply in the territory between Chicago and the Missouri River is 1.4 cents per 1,000 gals.

It is a well known fact that the scale found in boilers is a poor conductor of heat. The amount of heat retarded depends somewhat upon the nature of the scale. Moreover, much scale deposited in a boiler seriously interferes with the proper circulation of the water in the boiler. Authorities differ as to the extra amount of fuel required to convert water into steam in boilers coated with scale. One authority has stated that one-sixteenth of an inch of scale is equivalent to a loss of 20 per cent. of fuel, and that the loss increases in a rapid ratio with the increase of thickness of the scale. Another writer states that one-quarter of an inch of scale necessitates the use of 50 per cent. more fuel. There seems to be no question but that the efficiency per unit of coal is increased if a boiler is free from scale, but your committee has no definite information as to the exact amount.

Practical experience has shown that the use of soft water has greatly reduced the amount of boiler repairs. It is an established fact that boilers using soft water give very little trouble from leaky flues. A superintendent of motive power has stated that since the installation of 17 water-softening plants on a busy division of his road, 12 boilermakers are now required to keep up the boiler repairs where 23 were needed before the plants were installed. The chief engineer of another railroad that has 10 water-softening plants in operation on one division has stated that these plants are removing 2,790 lbs. of incrusting solids from the water per day, and that the saving in boiler repairs alone warrants the expenditure of the amount necessary to treat the waters. Another railroad has recently completed new repair shops that are strictly modern in every respect. In designing the boiler shop the floor space was made considerably less than the average for repair shops of similar capacity. This road has installed 10 water-softening plants, and has found from practical experience with them that the repairs to boilers were so much decreased that it would not be necessary, in order to keep up their boilers, to build a boiler shop of the usual capacity.

Inasmuch as the use of soft water decreases the amount of boiler repairs, it is not necessary to take the boilers out

*Abstract of a report to the American Railway Engineering and Maintenance of Way Association, March, 1904.

of service so often for repairs. It has been found that the use of soft water has lessened very much the time a boiler is out of service, but your committee has not been able to get exact figures. It is well known that it is often difficult to maintain the desired pressure in a boiler that has scale in it, and that locomotives are often unable to pull their maximum tonnage rating because the boilers contain much scale deposited from hard water. Your committee has endeavored to secure from the operating officers of railroads that have installed water-softening plants some information as to the comparative service of locomotives before and after the installation of the plants. One prominent operating officer states that the use of softened water has been of great help to him in the prompt and rapid movement of trains. Another has stated it would be a great advantage to have all the water used on his road softened so that locomotives could be transferred from one district to another and still use practically the same kind of water, because it is a well known fact that when locomotives are transferred and the character of the water changed they generally give trouble for some time.

Since the use of soft water decreases the time necessary for keeping locomotives out of service for boiler repairs, and for washing out; the number of locomotives required to operate a line should be decreased. Your committee has found published statistics covering a period of time on a division of a railroad that recently was equipped with water-softening plants. These statistics show that the number of locomotives in service was 9 per cent. less, the ton mileage 11 per cent. more, and the pounds of coal consumed per 1,000 ton miles was 5 per cent. less than during the same period before the division was equipped with the water-softening plants.

It is a well-established fact that a thick deposit of scale on boiler plates allows them to become overheated and often causes the plates to bulge and crack. It is also well known that boilers of locomotives that run in districts where the water is soft last much longer than the boilers of locomotives that run in districts where the water is hard. A test was recently made by a railroad with a locomotive that ran on a branch line and used nothing but water that had been softened. The boiler of this locomotive was kept hot continually for 30 days. It was noticed that the trouble due to leaky flues and staybolts was very much decreased. It is considered good practice in the maintenance of boilers to keep them hot as much as possible. The wear and tear due to cooling off and reheating is considerable. The use of soft water does away with the necessity of doing this so often.

The Engineering and Maintenance of Way Association Convention.

The fifth annual meeting of the American Railway Engineering and Maintenance of Way Association was held in the Auditorium Hotel, Chicago, March 15, 16 and 17, and was one of the most successful the Association has had. The total membership is now 445, and 153 were in attendance at the meeting. The Treasurer reported a balance on hand of $4,900.

A number of amendments were made to the constitution: The term of office of the president and vice-presidents will hereafter be two years, of the secretary and treasurer one year, and of the directors three years. The president is not eligible for re-election to that office for eight years. A professor of engineering in a college of recognized standing is eligible for membership. Chicago has been established as the permanent place of meeting, by constitutional provision.

The officers for the ensuing year are: *President*, Hunter McDonald (*re-elected*); *First Vice-President*, H. G. Kelley (*from* 1903); *Second Vice-President*, James Dun (*two years*); Treasurer, W. S. Dawley (*re-elected*); *Secretary*, L. C. Fritch (*re-elected*); *Directors for three years*, Walter G. Berg and W. L. Breckenridge.

President Hunter McDonald in his address said the Association was about to celebrate its "wooden wedding," and, like the newly wedded couple, "we have much to learn about each other, the management of our household affairs and the training of our children." . . . "As a general proposition everybody loves a good listener, but if all remain listeners there will be none to love us." A marked improvement in the quality and make-up of the reports for this convention was noted, and their early publication in the Bulletin has already produced valuable written discussion. In a closing reference to the work of the convention, the need for mastering the science of transacting a great deal of business thoroughly in a short space of time was urged. The capacity of the mill must be increased rather than reducing the supply of grist, keeping the output always of the first quality.

DISCUSSION OF REPORTS.

Reports were taken up for discussion in the order of their publication in the Bulletin.

Buildings.—This was received as a progress report and referred back to the committee. One feature to which special attention was directed was the form of contract recommended. It was stated that criticisms and discussions of this blank form had been received from the attorneys of different roads too late for presentation to the convention. They would be published in the Bulletin.

Mr. Berg (Lehigh Valley) thought this one of the most important subjects the committee had considered. Railroads are still prone to make a building contract in the same form as an ordinary railroad contract. The result is that there are a great many clauses to which contractors and builders bidding on the buildings are not accustomed, and which frighten them. A standard which the Association could agree upon would be greatly to its benefit.

Ties.—This report brought out a general discussion of the scope of the definitions of terms contained in the report. The particular definition precipitating this discussion was "pole tie," and it developed that there are several different kinds of ties which have this name in different parts of the country. The committee's definition—"a tie made from a tree of such size that not more than one tie can be made from a section. Such a tie generally shows sap wood on two sides"—was adopted.

A discussion of the definition of "slabbed tie" developed the fact that there are two kinds of ties ordinarily known as slab ties in different sections of the country, one of which is made by slabbing at the mill and the other made from slabs.

When the specifications were taken up, considerable discussion arose over a suggestion to insert the word "growing" before "timber," in specifying the sort of timber from which ties should be made. It was contended that the omission of the word would admit dead timber. Attention was directed to the fact that growing timber is dead except at the outside surface; and if a tree has been dead for some time it is still perfectly sound unless a fungus growth has started in it. The clause was finally amended to include "growing." Definitions of "hewn tie" and "sawed tie" were added, and the committee was instructed to define "tie."

Yards and Terminals.—The conclusions of the committee were adopted without discussion.

Taking up the definitions, that of the term "yard" was referred to and a change suggested. There was a vigorous discussion in 1901 of the definitions of the terms "yard" and "cluster yard" without a satisfactory conclusion having been reached, and the committee's definitions were allowed to stand for the time being. Mr. Berg suggested that after several years of use of these terms the committee would now probably be in a position to revise its definitions and moved that a systematic code be presented for review next year, which motion was adopted.

A feature to be considered in next year's report is hump and gravity yards.

Records, Reports and Accounts.—The conclusions, including the definitions, were adopted. A new conclusion was included as No. 7, reading: "It is recommended that duplicate copies of record books and maps, particularly right-of-way maps, should be kept in quite widely separated localities, so that the trouble and expense of reproducing same will be greatly reduced in case of fire or accident."

The committee asked the convention to indicate what ledger accounts it thought should be kept and to what extent it thought money should be expended for keeping such accounts. Mr. Churchill (Norfolk & Western) said they had saved a good deal of money each year for several years by making, at the time of the annual bridge inspection, detailed estimates of the cost of the work to be done to each bridge for the year, the endeavor then being made by all concerned to keep within these estimates. With a scheme of this sort, ledger accounts are not needed, most of the clerical work being done beforehand.

Mr. Berg explained that the committee had in view obtaining the total cost of a structure or piece of work and obtaining unit costs therefrom, so that there will be a record to show how much a certain piece of work cost, for comparative purposes.

The subject was referred to the committee for further report.

Signs, Fences, Crossings and Cattle-Guards.—An important point discussed under this report was the matter of galvanizing the wire for fences. The committees had made some investigation of the matter. The correct process is to coat the metal with tin and then immerse it in a zinc bath. Present practice is to put the metal through a bath of molten zinc, omitting the tinning process altogether. If the wire were exposed to moist air only there would probably be no action, but around railroads where there are large quantities of coal gases containing sulphurous and sulphuric acids the zinc coating does not afford the requisite protection. In fact, some chemists hold that the zinc assists deterioration under such conditions and that the naked wire would be better; that tin is the proper protective coating to use. Some say that the cost of the tin-coated wire would more than offset the saving from longer life. Zinc costs at present 4½ cents and tin 29 cents a pound. The increased cost of tin-coated wire would be about 1 cent a pound. No figures on the relative lives of the two could be given.

The specifications were received as a progress report and referred back to the committee, with a request for information on the breaking strength of fence wire.

Conclusion No. 3 of the committee recommending the use of a heavy, smooth wire or a plank at the top of barbed-wire fences aroused considerable discussion. Some members stated that they had followed this practice, with the result that cattle putting their heads over the fences, or persons climbing over, would break them down, obliging the owners to resort to the use of a barbed top wire for woven-wire or barbed-wire fences. The primary object of the plank, which is required by law in some States, is to enable cattle to more readily see the fence.

The committee recommended the surface cattle-guard, explaining that the pit guard contains elements of danger. Questions arose regarding the laws of different States relative to cattle-guards. Mr. Churchill (N. & W.) stated that they had won an important suit in Virginia, establishing the legality of the surface guard. The convention voted unanimously to adopt the surface guard.

Rail.—Paragraph 4 of the specifications, which refers to the number of passes and speed of train and final temperatures, had this addition made to it: "The above shrinkage allowance may be varied if necessary so as to give a finishing temperature of 1,600 deg. F. at finishing rolls for mills rolling from reheated blooms, and 1,750 deg. F. at finishing rolls for mills rolling direct from the bloom to finished rail."

The committee decided to call for one drop test for each heat of steel, and in the ensuing discussion Mr. John McLeod of the Carnegie Steel Company took part. He said he thought the requirement of one test for each blow a mistake. One test from five blows would amply test the material, as that gives two tests per melt, checking the mixture twice. One test for each heat would mean a test every three minutes throughout the day which would be bound to cause delays to shipments and impose a hardship on the mills. In reply to a question he said the daily capacity of their rolls was about 3,000 tons, and there were about 200 blows. The number of tests per hour would therefore average 20.

Mr. P. E. Carhart, of the Illinois Steel Company, said that at one time they made a test for each heat, and as a result they often had as many as 80 to 100 cars held back waiting for the drop tests to be made; and they were working 24 hours a day.

Mr. F. E. Abbott explained that the object of the tests was to keep clear of brittle steel, so that no rails would be got into the track which would break under trains. He explained the process by which the metal passes through the mixers. They hold from 100 to 150 tons, and 10 or 12 tons are drawn out each heat. The mills have no desire to send out brittle steel, and yet they consider one test in five heats sufficient check. Brittleness is due to phosphorus, which would not be confined to one heat, but would extend through the mass, so that it would be caught in one test in five heats.

Mr. W. R. Webster (Chairman of the committee) contended that while one test in five might be a test on the quality of the material in the mixer, that it would be necessary to assume that the blowing of each heat and also the finishing temperature would be uniform and this would be a good deal to assume. A test for each heat would check this.

Mr. Cushing (Pennsylvania Lines West) said the discussion was going on the assumption that the roads are getting good rails, while as a matter of fact they are getting the worst in their history. The trouble is not brittle rails, but squash rails, his road's trouble being mostly from mashed heads, split heads, soft material, etc. Also a great many piped rails are found.

On the Norfolk & Western Mr. Churchill said they had not for several years had any broken rails due to faulty composition. The trouble was always from incipient flaws, and he therefore did not place great weight on the drop test. The trouble was as stated by Mr. Cushing, and the drop test would not help to detect poor rails.

Mr. Webster said the trouble was due to the large grain in the rail head from being finished too hot and the shock of the drop test would cause such to fracture, furnishing a check on the finishing temperature.

The committee's recommendation for drop test was adopted.

Ballasting.—The most important feature of the discussion of this report related to the thickness of ballast under ties, the committee having recommended that a minimum thickness of 6 in. be considered as ballasted track, but that a minimum thickness of 8 in. be preferred. Many members thought the minimum should be 12 in. After considerable discussion a motion was made and carried to eliminate from the specifications the clause relating to quantity in track, refer same back to the committee for joint consideration with the track committee, the recommendations to cover three characters of track, viz.: (a) main lines with heavy traffic; (b) subsidiary lines with medium traffic; (c) branch lines with light traffic.

Track.—Considerable discussion was provoked by a suggestion of Mr. W. M. Camp, in connection with the committee's definition of "gage" (track tool), that the gage be measured from the top corners of the rail instead of 1⅝ in. below the top, using a lug $^{17}/_{64}$ in. long. Many members thought that gaging curve-worn rails with such a tool would result in making the curve too tight, causing broken flanges and other serious troubles. The relation of wheels to rails on curves should be such that when the truck is forced to one side and the wheels rise on the flange fillet, the force of gravity will tend to throw the truck back toward the center, and some play should be allowed between wheel-flange gage and rail gage, permitting the trucks to oscillate. If the present gage is applied to a rail on a curve, worn ½ in. at the top, and the base has not moved, the track is to gage, and the rail would not be moved; though it would if a gage with ¼-in. lip were used.

Mr. Cushing said they were very conservative in making allowances for gage spread on sharp curves, insisting on a tight gage. He thought 1⅝ in. too far down to measure gage on curves and did not think it necessary to spread the gage on curves up to 6 deg.

After considerable further discussion the definition was

referred back to the committee for further consideration and report next year.

Under "maintenance of gage" the question of tie-plating curves came up. The committee recommended tie-plates on all ties for heavy traffic and for medium traffic on all curves over 3 deg. These recommendations, with a third providing that for light traffic the outside rails be double-spiked, were adopted after a lengthy discussion of what these traffic terms might include, and with the understanding that an additional recommendation should be adopted providing as follows: "Tie plates shall be applied in all cases where greater economy of maintenance is secured by their use than by depending on the life of the tie, limited by rail wear."

The recommendation of the joint committee from the Rail and Track committees relative to standard drilling were included in the Track report and after some discussion a motion to have the recommendations apply to six-hole angle-bars only was adopted.

Masonry.—The concrete specifications were first considered, item by item. Under "forms" it was suggested that the kind of lumber to be used was important, since in material dressed on but one side there is no assurance that it will be of uniform thickness and as the unsized side goes against the uprights the surface of the concrete will be irregular. It was further suggested that the planking should be of uniform width, and after discussing the matter at length, the clause was amended to read: "For all important work the lumber used for face work shall be dressed on one side and both edges to a uniform thickness and width, and shall be sound and free from loose knots, secured to the studding or uprights in horizontal lines."

The report provided that expansion joints should be provided at intervals of from 50 to 100 ft. Some members were of the opinion that the minimum length should be reduced, Mr. Cushing advocating 30 ft. or three per 100 ft. Mr. Parkhurst also advocated joints of greater frequency, especially on work built in warm weather. He spoke of having examined in freezing weather the new retaining wall at Galveston, with sections 50 to 55 ft. long, and found at the end of every third or fourth section that the joints were open ⅜ in. Mr. Atwood (P. & L. E.) pointed out that this meant ⅜ in. in something like 200 ft., or about ⅛ in. per 50 ft., which was not objectionable.

Mr. Kelley (M. & St. L.) told of a roundhouse he had built of concrete blocks last summer, using solid concrete pilasters between angles and bonding the blocks into the pilaster. The dimensions between pilasters was about 25 ft. Recently when the temperature went to 35 deg. below zero, the contraction of the wall caused a crack to form in each section from cornice to window and from window sill to ground. This indicated the need of proper provision for expansion and contraction.

The committee's recommendation was amended to read "from 30 to 100 ft. as the character of the structure may require."

Another interesting point related to coating the finished faces of concrete work with a thin grout. Mr. Scribner, the builder of the Big Muddy bridge of the Illinois Central, said he did not consider this wash necessary. Mr. Parkhurst said that in the large amount of concrete work the Illinois Central had done lately, the finish was obtained by putting mortar joints next to the molds and taking the molds off after a reasonable time.

Mr. J. W. Meade (Santa Fe) told of a concrete dam in Oklahoma in which rough plank was used for the back. When the form was removed the back was found to be honeycombed badly. It was gone over three times with a wash and was made perfectly smooth. Mr. Brown (Chairman of the committee) said he had used a wash for several years with entire success, and no tendency to flake or scale off had ever been observed. He used rough lumber and finished in this way.

The committee's recommendation was adopted.

Under "freezing weather," the report recommended the use of salt in the proportion of about 2 lbs. per cu. yd. The President thought the salt should be specified in proportion to the number of gallons of water. In the discussion which followed Mr. E. Hart (N. Y., C. & St. L.) said that his experience has been that the safest way is to use all of the salt the water will hold and to that end he uses a large tank with a surplus of salt, through which the water is run, the mixture being stirred by steam.

Under "reinforced concrete" the report recommended that no work of this character should be laid in freezing weather. Mr. Scribner spoke of having carried on his work in freezing weather with entirely satisfactory results, by heating the sand and stone and boiling the water. Mr. C. H. Cartlidge, of the C., B. & Q., told of work they had done in zero weather by heating the material. Observations showed that the concrete had not reached the freezing temperature 24 hours after, although it had set some hours previously.

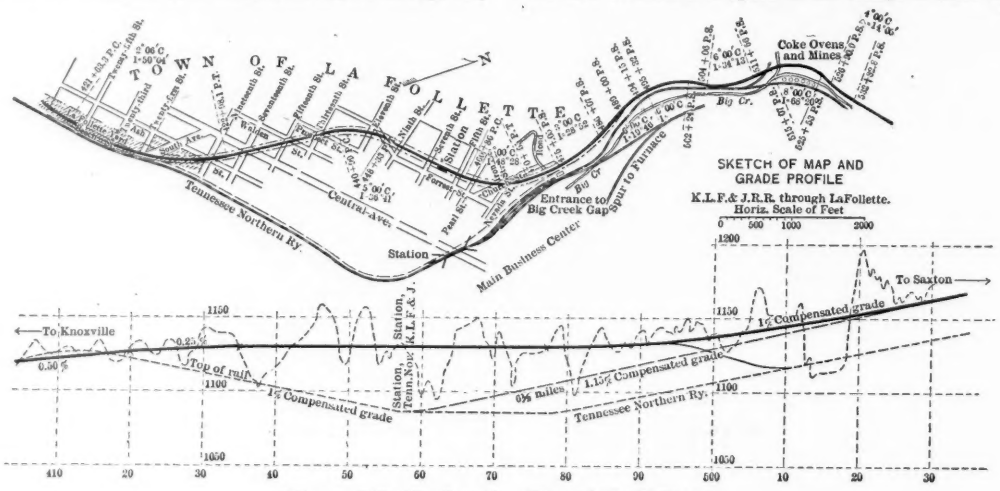
On motion the committee's recommendation was stricken out.

The Association recorded, in adopting a resolution offered by Mr. Camp, its appreciation of the work thus far accomplished by the Bureau of Forestry, U. S. Department of Agriculture, in determining the strength of various commercial timbers of the United States, in investigating the best methods for handling and preserving timbers to the end that safe, economical and durable structures may be built and sources of supply otherwise neglected may be made available and in promoting the economical use of existing supplies and in making possible the conservative administration of forest tracts in the general interests of forestry. The Secretary of Agriculture was urged to request Congress to make such appropriation as may be necessary to carry on the work in the most effective and satisfactory manner.

The Location of the Knoxville, La Follette & Jellico Railroad.

(*Continued from page 216.*)

The drawing shows a map and profile of the old and new line at Copper Ridge. By dropping the grade line about 50 ft. at the summit and making a 2,170-ft. tunnel, and by taking advantage of the sharp fall in Beaver Creek valley toward the gap, the 34-ft. grade could be used even here without lengthening the line and without increasing the cost, except by a portion of the cost of the construction of the tunnel. In fact, the lighter grade threw the line off from the upper clips of the ridge in certain places down on to the talus slope on smoother ground, with the result that a very much better line, both in alinement and first cost (except for the tunnel) was obtained. In the revision surveys here a maximum curvature of 6 deg. was substituted for 10 deg. This change had the effect of placing the tunnel of the summit of the ridge on the grade up to Beaver Creek valley, and there was elevation enough to spare to permit of dropping the grade to 23 ft. per mile through the tunnel, thus compensating for wet rails by more than 0.2 per cent. Thus the cost of the change at these two points was not in excess of the cost of the other line by anything like the full cost of the tunnels. The construction contracts which had been made would warrant the belief that the tunnels could be constructed at a much lower figure, but, inasmuch as these tunnels had to be constructed in part through very



Map and Profile Location Through La Follette.

treacherous clays, it will be supposed that they would cost $90 per linear foot. Not considering the 50 ft. of adverse grade saved at Black Oak Ridge No. 2, the additional cost of the two tunnels would be about as follows:

700-ft. tunnel at Black Oak Ridge No. 2, at $90	$63,000
2,170-ft. tunnel at Copper Ridge, at $90	195,300
Total	$258,300
Less cost of summit cut at Copper Ridge—	
93,000 cu. yds. earth excavation, at 20 cts.	$18,600
49,000 cu. yds. chert excavation, at 28 cts.	13,720
44,000 cu. yds. rock excavation, at 70 cts.	30,800
	63,120
Additional cost of tunnels	$195,180

The approaches to the tunnel at Black Oak Ridge No. 2 were very nearly as costly as the original summit cut. There was another expense which constituted a legitimate charge against the construction of the tunnels. Up to the time of the contemplated change, the longest tunnel on the road was in the mountain district, in good material, and was less than 900 ft. long. It was certain that the construction of these tunnels would take much longer than the remainder of the road; therefore, the interest on the money invested in construction, including the cost of the valuable property purchased in Knoxville for terminals, from the time that the other work could be completed until the tunnels could be completed, constituted a proper charge against the proposed change. Taking the amount expended in other construction, etc., as $3,500,000, with interest at 4 per cent., and supposing that the tunnels delayed the opening of the road for traffic one year, then the total cost of changing to the lighter grade for southbound trains would be as follows:

Establishing helper-engine service on the Cumberland-Clinch Divide	$345,975
Additional construction cost of two tunnels	195,180
Interest on $3,500,000 for one year at 4 per cent., on account of delay	140,000
Total cost of change to lower grade	$681,155

The value of such changes is difficult to estimate with accuracy, even on an operated road on which the traffic is known. It was reasonably certain that the road would not be in operation many years, if operated on 53-ft. grades, before as many as ten trains per day each way would be required to do its business. Considering the traffic the road would have, probably six of these trains southbound would be fully loaded. Four fully loaded trains per day, on a 34-ft. ruling grade, could just about do the work of six fully loaded trains per day on 53-ft. grades, using engines and cars of the same class. Since the northbound traffic would include a large quota of empty coal cars, and since the same engine that pulled, say, 23 loaded 40-ton cars southward against the 34-ft. grades could pull 49 empties back against the 53-ft. grades as far as La Follette and 44 empties back, even against the 61-ft. grade, it was probable that eight trains per day each way on the lesser grade would do the work of ten trains per day each way on the higher grade. Operating expenses vary directly as the train mileage, and the cost per train-mile on the Louisville & Nashville for the year ending June 30, 1902, is given in "Statistics of Railways" by the Interstate Commerce Commission as $1.08. However, it is a fact that the operation of such heavy trains as these costs more than the general average on a large system. The cost per train-mile on the Duluth & Iron Range and the Duluth, Mesaba & Northern, two roads engaged almost exclusively in traffic similar to that which these omitted trains would represent, is given by the same authority for the same year as $1.94 and $2.61 respectively. Probably it would be safe to estimate the train-miles saved at $1.50, but the more conservative figure will be taken. Suppose that half these trains run on Sunday. Then the annual saving from Saxton to Knoxville would be $1.08 x 4 x 79 x 339 = $116,000, nearly and the value of this annual saving in operation, with interest at 4 per cent., would be $2,900,000

The cost of the change, as above 681,155

The amount gained by the change $2,218,845

However, since helper-engine service could be established and maintained also at Black Oak and Copper Ridges, at a probable cost of $227,000 at each place, the engine mileage at either point not being more than half of that at the Cumberland Clinch divide, the utmost amount it would have been economical to spend on the change at these two points was about $454,000. Thus it was more economical to build the tunnels by the amount of $454,000 less $195,180 + $140,000, or $118,820. As soon as the President of the Louisville & Nashville Railroad understood the matter fully he authorized the change, without hesitation.

When the order was made to reduce the southbound grades to 34 ft., there were some long minor grades on which the curvature had not been compensated, so that the total resistance was above that of the new ruling grade. As the construction had barely begun on most of the line, the corrections were inexpensive; but, if the road had already been in operation, the failure to compensate the prevailing minor grades would probably have resulted in the adoption of a higher ruling grade than that which was applicable to the country. Even if the heaviest grades had not been reduced at the time, with the probable heavy traffic in prospect, it was almost certain that sooner or later the heaviest grades would have been reduced or operated by helper engines, so that it is clear that the heavier minor grades should have been compensated at the outset.

It was also now contemplated to reduce the southbound grades back on the operated road between Saxton and Corbin, and also on the Atlanta, Knoxville & Northern for some distance below Knoxville, to the same rate. Thus the plan became a part of a more comprehensive scheme.

Now it is true that, under ordinary conditions, if the road were laid out contemplating the use of a helper at any point, this adopted ratio of 1 per cent. and 0.65 per cent. for the helper grade to the ordinary is uneconomical; but if the helper engine is to be of the same class as the regular engine, the helper grade, ordinarily, could be as heavy as 1.4 per cent., if the grade for the regular engine was 0.65 per cent. But there were very good reasons why this 1 per cent. grade against southbound trains was not altered:

1. The contract for the construction of the road through the mountain district had been let for some months, and the work was well under way before this change to 34-ft. grades was contemplated.

2. The 1.4 per cent. grade would not have shortened the line at all, and the valley into which that grade would necessarily have descended was so narrow and rugged that there would have been little saving over the 1 per cent. grade.

3. On account of the peculiar conditions under which the road would probably be operated, it was in no wise certain that the 1 per cent. grade would be used as a

helper grade. But even if it were, and the grade revision was carried back or forward on the old road far enough to make up a complete freight division, there would be many a train which would not require the service of the helper on a 1 per cent. grade, and yet certainly would on a 1.4 per cent. grade.

The writer does not pretend that these adopted grades of 53 ft. and 34 ft. southbound, and 53 ft. and 61 ft. northbound, were studied out and adjusted accurately to the needs of the future traffic. The probable future traffic was considered, but the grades adopted were simply the best that the country afforded as a reasonable expenditure of from $40,000 to $60,000 per mile, below sub-grade, each of them being fixed by long, continuous ascents—to alter materially any one of which for the better could be done only at an expenditure not warranted by the anticipated traffic.

On the supposition that the plan of reducing southbound grades on the old road was not carried out, the scheme of operation, as affected by these grades, without using a helper engine, could be outlined roughly as follows:

It was certain at the outset that a spur line would branch off at the south end of the Narrows to the excellent, but undeveloped, coal fields of the Clear Fork and Laurel Fork valleys. It was also certain that a spur line would branch off in the neighborhood of Clinton to the coal fields in the vicinity of Oliver Springs. Thus, in operation, freight trains out of Knoxville would set off empties along the route till they were lightened sufficiently to pull up the 61-ft. grade north of La Follette. Going south, trains would leave the head of the Narrows with only such loads as they could pull on the 53-ft. grades, and would pick up enough loads at La Follette and other points on the route to load them fully into Knoxville.

Oliver Springs line, either at Lee's Ford or just on the north side of the Clinch, two miles below Clinton, which were regarded as the only available points. The proposed routes united near Dosset. To reach Dosset from Lee's Ford required three miles of road, a bridge over the Clinch and a tunnel through Black Oak Ridge No. 2. To reach Dosset from the second point required five miles of very heavy work and a tunnel through the same ridge. Either plan of building the branch line then would necessitate tunneling this ridge twice, once for the main line north of Clinton and once for the branch line southwest of Clinton. Since it was a fixed fact that the branch line would be built, it was suggested that it might be better to turn the main line southwest at a point three miles south of Coal Creek, take it through Dosset and make the point of junction for the branch line at Dosset. This plan would save the construction of one tunnel, and either one bridge over the Clinch and the construction and operation of three miles of road or the construction and operation of five miles of road. But it would miss the town of Clinton. Examination showed that, when the construction of both the main line and the branch line was considered as a whole, the proposed change was advantageous in point of alinement, distance and economy. The gradients of the main line were not benefited materially by the change, but those of the branch line were benefited very much. To tunnel the ridge on the branch line, with the gradients adopted for it, would have required 2,500 ft. of tunnel, but the gradients now decided upon for the main line required 3,520 ft. of tunnel. Thus, by saving the 700-ft. tunnel and the 2,500-ft. tunnel, and making the 3,520-ft. tunnel, there was 320 ft. more of tunnel to construct, but the cost of the expensive approaches to one of the tunnels was saved.

The town of Clinton was already well provided with railroad facilities, and it had not the population nor any industry to give it claim for consideration against such advantages. The last census showed that it was decreasing in population. Therefore the line was changed to pass through Dosset, and the further advantage was secured that, against southbound trains, the two principal branch lines have the same limiting gradients as the main line. Thus the road is laid out somewhat on the same principle as that by which a stream departs from its direct course to meet its principal tributaries.

The road, as located finally, is 78.8 miles long from Saxton to Asylum street in Knoxville, making the length of road exceed the straight line distance 55 per cent., instead of 34 per cent., as by the Knoxville and Ohio branch of the Southern between the same points.

The roughest country encountered was from the head of the Narrows to the Cumberland-Clinch Divide, and here 10-deg. curves were used. Quite expensive construction was necessary on the south side of this divide as far as La Follette, and here a maximum of 8-deg. curves was used. Rough country was also encountered in the six miles north of Coal Creek and on the ascent through Copper Ridge. The sharpest curves used at the last two points were 6 deg.; the remainder of the road was located on light curves, so that the points where curvature would reduce high speeds materially were bunched. From Saxton to La Follette there are 92 curves, the total angle turned being 3,717 deg., or 145 deg. of curvature per mile. From La Follette to Knoxville there are 119 curves, with a total central angle of 3,692 deg., or 69 deg. of curvature per mile. The minimum tangent was 300 ft. and all curves above 2 deg. were spiraled. The Holbrook spiral, with three different rates of spiraling, was used. For curves under 5 deg. a spiral increasing 1 deg. in 60 ft. was used (called a 60-ft. spiral). For curves above 5 deg. and under 7 deg. a 30-ft. spiral was used, and for curves of from 7 to 10 deg., a 24-ft. spiral was used. It will be noticed that the rate of spiraling is changed sharply in passing from curves of about 4 deg. to those of lesser radius. The reason for this was that curves of 4 deg. and less, with 60-ft. spirals, were intended to be used in open country, and the curves of higher degree, with the 30-ft. spirals or less, were intended to be used only in country where it was necessary to use curvature of such high degree as would necessarily limit the speed of fast trains. The curves were located originally without spirals, but the resident engineers put in the spirals just before staking out the work, so that the road was constructed on the spiraled alinement. It will be noticed that these spirals would all fit in, usually with some distance to spare, on the 300-ft. tangents.

The grade breaks were rounded off by vertical parabolic curves, changing the rate of grade 0.2 ft. per 100-ft. station at summits, and 0.1 ft. per 100-ft. station in sags.

On the final location adopted, there were seven tunnels, in the 79 miles of road, aggregating nearly 10,000 ft. in length. One of these tunnels in the mountain district was located partly on a 10-deg. curve, so that the spiral approach curve, with its varying curvature and rail superelevation, came within the tunnel. The rule used for increasing the tunnel section, so as to give at every point practically the same clearance as on tangents, for an 80-ft. Pullman or dining car, was:

Widen the tangent section 13/16 in. per degree, both on the inside and on the outside of the curve. In addition, widen the section on the inside of the curve 2 11/16 in. per each inch of superelevation.

The particular tunnel was in hard sandstone not requiring lining. The tangent section was rectangular from subgrade to 17 ft. above (16 x 17), with curves of 5-ft. radius in the upper corners. The rule gives a slight excess of clearance on the outside of the curve, which, to some extent, allows for the compression and swing on the car springs.

At the time of writing this paper (December, 1903), practically all the grading, except that in the Knoxville yards, is completed. Several of the tunnels are completed, but the 3,520-ft. tunnel at Dosset cannot be completed, probably, before some time in the summer of 1904. The main line is being built with permanent structures, no timber bridges or bridge supports being used, except four wooden trestles which are to be filled in, eventually, with steam shovel and train.

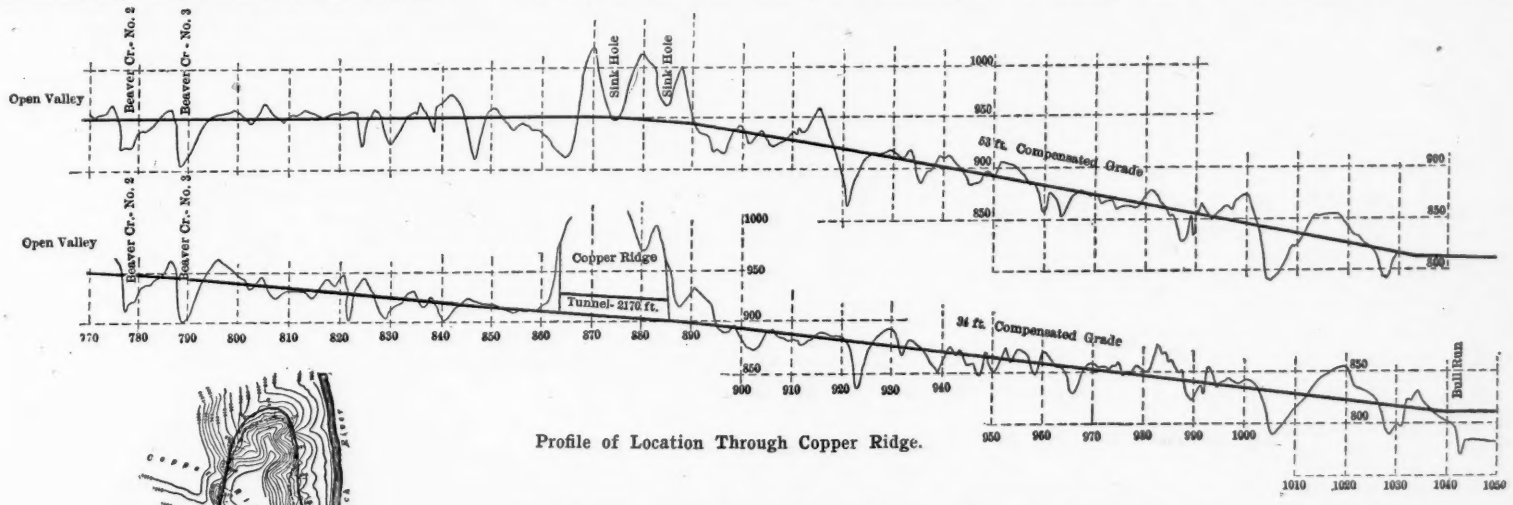
Of openings on the main line, there are eleven concrete and stone masonry arches of from 12 to 26-ft. span. There are 30 steel bridges, on masonry piers and abutments, and two viaducts of 1,420 ft. total length. These steel bridges consist of three through spans, one of 150 ft. and two of 200 ft., and 67 plate girders of the following kinds writing their lengths to the nearest 5 ft.: One 40-ft. through, one 45-ft. through, one 80-ft. through, and one 45-ft. double track deck and single-track deck girders of the following lengths and number: Two 14-ft., six 30-ft., six 40-ft., eleven 45-ft., one 50-ft., nine 60-ft., twenty-one 70-ft., one 90-ft., and one 120-ft. In these structures there are 43,529 cu. yds. of first and second-class bridge and arch masonry. In addition, there are 37,248 cu. yds. of culvert masonry.

The total cost of building the main line ready for operation, exclusive of rolling stock and equipment, is now estimated to be $5,450,000, or a little in excess of $69,000 per mile. The cost of the Oliver Springs Branch is estimated to be $300,000 and of the Clear Fork Branch $93,000.

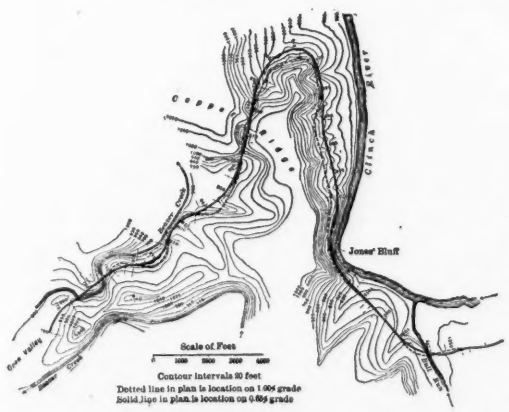
As will be inferred from the foregoing discussion, in the lay-out of the road far more weight was given to gradient and the securing of traffic than to curvature and distance. If economy in operation is in any wise proportional to the smoothness of the grades it is an economically located road, considering the country. In seeking a measure of grade smoothness for such a purpose the smoothness of a gradient should be taken to vary inversely as the total number of feet, vertical, ascended and descended on maximum, or at least on expensive, grades; but, taking the smoothness to vary inversely as the total number of feet ascended and descended, some interesting comparisons may be shown.

From the crossing of the Clinch, at Clinton, to Knoxville, on the Knoxville and Ohio Branch of the Southern, the total rise is 641 ft. and the total fall 601 ft., or a total average rise and fall per mile of 59.2 ft. From the crossing of the Clinch, on this line, to Knoxville, there are 290 ft. of rise and 264 ft. of fall, making a total average rise and fall per mile of 21.5 ft. Measured as above, the smoothness of this new line exceeds the smoothness of the old line in the same country by 173 per cent.

In this respect the smoothness of this road compares favorably with the smoothness of some prairie roads. The average total rise and fall per mile from Saxton to Knoxville is 26.2 ft. The average total rise and fall per mile of one of the principal roads from Kansas City to Chicago, for the first 100 miles out of Kansas City, across the Missouri prairies, is 37.2 ft. per mile. Thus, measuring grade smoothness by this standard, the smoothness of this mountain road, crossing the direction of the prevailing ridges and ranges, exceeds the smoothness of this prairie road by 42 per cent.


Open Valley
Beaver Cr.- No. 2
Beaver Cr.- No. 3
Sink Hole
Sink Hole
53 ft. Compensated Grade
Open Valley
Copper Ridge
Tunnel- 2170 ft.
34 ft. Compensated Grade
Bull Run
770 780 790 800 810 820 830 840 850 860 870 880 890 900 910 920 930 940 950 960 970 980 990 1000 1010 1020 1030 1040 1050

Profile of Location Through Copper Ridge.


Jones Bluff
Scale of Feet
Contour Intervals 20 feet
Dotted line in plan is location on 1.0% grade
Solid line in plan is location on 0.6% grade

Location Through Copper Ridge.

The writer has been so impressed with the number of instances he has met in his practice in which engineers have lost sight of the important principle of making a diligent study of the country, that a special instance, illustrating how some expensive and unnecessary rise and fall was avoided, will be cited.

The survey for this road was commenced under some other engineers at La Follette, proceeding northward. The idea in mind was to parallel the Tennessee Northern through the town, as shown in Fig. 4, and to use the station already built for both roads. The same parties controlled the Tennessee Northern, all the industries and most of the land near La Follette, and it was considered by them of very great importance to their plan of development that through the town the old road should be paralleled by the new. The 6½-mile 61-ft. grade from the Cumberland-Clinch divide did not "touch bottom" until just before the station was reached. The profile shows the hole in which the station would have been if the original location had been retained. The line finally adopted by the writer is shown in the map and profile. It was about as cheap to build as the other, gave less curvature and was some 700 ft. shorter. The comparative advantage in the operation of this upper line as adopted was so palpable that it was never attempted to calculate how much more economical it was than the former line. To put the station of this important town in such a place as was contemplated, with 43 ft. of unnecessary maximum grade immediately on each side of it, would have been bad engineering even if the traffic from this point alone was to be considered, but to put a station on a through line in such a place, at which all heavy trains would probably have to stop, when it could be avoided at any reasonable outlay, would have been the height of folly.

After all the contracts for the construction of the main line and the Clear Fork Branch were let, it was found that it required very expensive construction to connect the

RAILROAD GAZETTE

ESTABLISHED IN APRIL, 1856.
PUBLISHED EVERY FRIDAY
At 83 Fulton Street, New York.

EDITORIAL ANNOUNCEMENTS.

CONTRIBUTIONS.—Subscribers and others will materially assist us in making our news accurate and complete if they will send us early information of events which take place under their observation, such as changes in railroad officers, organizations and changes of companies in their management, particulars as to the business of the letting, progress and completion of contracts for new works or important improvements of old ones, experiments in the construction of roads and machinery and railroads, and suggestions as to its improvement. Discussions of subjects pertaining to ALL DEPARTMENTS *of railroad business by men practically acquainted with them are especially desired. Officers will oblige us by forwarding early copies of notices of meetings, elections, appointments, and especially annual reports, some notice of all of which will be published.*

ADVERTISEMENTS.—We wish it distinctly understood that we will entertain no proposition to publish anything in this journal for pay, EXCEPT IN THE ADVERTISING COLUMNS. *We give in our editorial columns* OUR OWN *opinions, and these only, and in our news columns present only such matter as we consider interesting and important to our readers. Those who wish to recommend their inventions, machinery, supplies, financial schemes, etc., to our readers, can do so fully in our advertising columns, but it is useless to ask us to recommend them editorially either for money or in consideration of advertising patronage.*

The Anthracite Coal Workers.*

No permanency of relation in the Anthracite region was secured in the drawn battle, in the strike of 1902, which cost $100,000,000. It will need to be dealt with again and again, and Mr. Roberts' complete study of the characteristics of the 630,000 persons whose support comes from the mining of anthracite is indispensable to those directly interested and of interest to all thoughtful people. The anthracite coal fields lie in the northeastern part of Pennsylvania, in the counties of Lackawanna, Luzerne, Carbon, Schuylkill, Columbia, Northumberland and Dauphin. These scattered deposits cover 480 square miles, but they include a region of 1,700 square miles. A large proportion of the 140,000 employees live in squalor, under foul, unhygienic conditions, the penalty for which is a yearly tribute of disease and death. The children grow up in the dismal surroundings of a blighted land, with culm heaps, strippings, bare and barren hills, from which even the songbirds have gone, and polluted streams in which fish can no longer live. The physical and moral effects on childhood and youth in such an environment are precisely what might be expected.

The problem is largely that of dealing with the Sclav. Their children attending the public schools find that institution at its worst, governed by school directors who seek the office for greed, nepotism and corruption, fair representatives of a grossly ignorant community who force upon the schools teachers whose influence for good is often slight. The average school life of the boys of mine workers is less than 4½ years. A large proportion of these boys leave school and go at work before they are 11 and more than half are out before they are 12 years old. Nevertheless, they learn to speak and to read the English language and by so much there is a gain in intelligence and a hope in dealing with them in the future.

In the first 50 years of the anthracite industry in Pennsylvania, Great Britain and Germany furnished the laborers, but in the severer parts of the work, in the thinner veins, coarser and more acquiescent human material was needed. It was gladly supplied from the regions east of Germany, bounded by the Ural mountains and the Baltic sea, the Black sea and the White sea; a hardy race of clumsy, industrious workmen, ignorant, drunken, unclean and brutal.

The Sclav is unpromising material for good citizenship, but he is an ideal trade-union man, obedient to leadership and long enduring as a striker. One-half of the anthracite mine workers are Sclavs, and the field is Arcadia for the walking delegate. The Sclav multiplies exceedingly, but with his own kind only, for native and other foreign-born women will not marry him. This makes it bad for those women, for the number of native, British and German spinsters is increasing unduly, and the tendency is toward the full occupation of the anthracite field of labor by the Huns, Magyars and their like. Adult laborers get an average wage of something like $500 a year, but "average" does not mean much. In this case, as in most others, it is not true of any one person; it is simply a figure which is a mean between the earnings of the idle and the industrious. The industrious and thrifty do well. Already the Sclavs have an average ownership of real estate of the value of $100 per man. The author believes that more wages or shorter hours will not benefit the men who live in the shanties and dwellings owned by the coal companies; that the only present hope for betterment is for the companies to build comfortable homes and allow the workmen to buy them on fair and easy terms. It would seem that the author is right. A debt for purchase money is a bond for industry.

The responsibility for bettering things in this region, as in all cases, rests primarily with those most deeply interested, and here it is the owners of the industry. It is, or should be, fortunate that this ownership is held by a few highly organized corporations managed by officers of unusual capacity, and surely such advantages as monopoly has should be got here. It is too late to have proprietary towns, such as Pullman, and this is fortunate. They have not, and they should not, interfere in the local governments, bad as they are. They have made attempts, more or less successful, and on different plans, at pension and sick and accident benefit systems. These should be improved and continued. They should, and we now believe that they will, deal fairly and kindly with ignorant, unreasonable men and look hopefully for a gradual slow improvement in their reasonableness. But all this goes for little without a sturdy enforcement of the law and a respect for the owners' rights and a manly fight against interference by politicians. They need only high intelligence among themselves and the full protection of the law.

*"Anthracite Coal Communities," by Peter Roberts. Published by The Macmillan Co., New York.

Eminent Domain Vs. Minority Stockholdings.

The swift railroad consolidations of the last few years have left in their wake not a few groups of minority shareholders of both main and branch lines; and in a great many cases, for various reasons, the minority has been opposed to the action and attitude of the majority, when it seeks a merger of the subsidiary line. Why comparatively few of these collisions of interest have reached the courts is easy to discover. The legal questions involved are often complex, sometimes not well settled in law and pretty sure to involve long delay and high costs. When the minority is a powerful one compromise is apt to follow a warm controversy of interests; and when the minority is small but obstinate or aggressive it is usually better to buy it out than to appeal to the uncertain courts. There are some signs, nevertheless, as the slow process of buying out minorities begins to reach the residuary stockholders who either refuse to sell or who demand an exorbitant price, that we shall find more cases of litigation in the nature of condemnation proceedings and affecting the relative rights of the corporation against the outstanding share owner.

Such a case of majority versus minority, involving condemnation of shares under eminent domain, has just been raised in Connecticut by the New York, New Haven & Hartford Railroad Company against one residuary shareholder of the New Haven & Derby, a small branch line. The statute under which the case falls is unique. It was enacted in 1895 and provides that any railroad company acquiring more than three-fourths of the capital stock of any steamboat, ferry, bridge, wharf or railroad corporation may, if the minority refuses to agree on terms of sale, and if a superior court judge finds that such sale "will be for the public interest," cause the value of the stock to be fixed by three appraisers appointed by the judge under exactly the same proceedings as are had in the condemnation of real estate. A section immediately following and enacted at the same time, evidently as a kind of makeweight, provides for precisely the same right of procedure by a minority stockholder against a railroad corporation holding more than three-fourths of the stock. This odd provision repeats one inserted in the act of consolidation of the New York & New Haven and the Hartford & New Haven companies thirty-two years ago. But it is referred to here incidentally. The main fact is the assertion in the earlier section of the right of eminent domain as against the minority shareholder. The constitutionality of the particular act has been disputed by eminent Connecticut lawyers and now, at last, seems likely to be settled in the State courts.

The general question of the power and rights of what may be called the majority railroad corporation seeking the residuary and minority stock in a second railroad corporation has two distinct viewpoints. Leaving for the moment the laws and the precedents, and looking at the subject as a layman who puts equity and morals in the foreground, one finds two extreme propositions both based on common experience. On the one hand, is the controlling corporation "freezing out" the minority shareholder by any one of several expedients. It may try to starve out the stockholder by starving the subsidiary road. It may lease the road below the normal or fair dividend. It may reduce the dividend or cut it off entirely. It may direct traffic to the injury of the subsidiary line and the benefit of the controlling corporation. There are cases, and not unfamiliar ones, at one extreme. At the other stands the resisting and dissenting stockholder who may be merely obstinate, stupid or cranky; and who also may be—and often is—a shareholder who avails himself of his artificial advantage and his obstructive power to "strike" the controlling corporation. Between the two extremes, the "freeze out" on the one hand and the "strike" on the other, lie a large range and variety of equities which, obviously, can be weighed in connection with each separate case. It is on such intermediate ground of equity that the conflicts of majority and minority interests have usually been adjusted outside of the courts and of technical law.

As distinguished from the foregoing viewpoint of ethics and usage the question of law opens a different field. Laying entirely aside, for the moment, the power of eminent domain, as an original proposition the minority shareholder cannot be coerced into consolidations and mergers by the majority. In essence his certificate of stock represents a signed contract with the corporation—a contract in which he accepts the terms of its charter and nothing else. He cannot be called upon against his will to go into new ventures or hazards either in his own corporation or in the corporation that seeks to merge his subsidiary stock, or to surrender his rights under it. Lord Eldon's words on partnership apply here when he says: "The right of a partner is to hold to the specified purposes of his partners while his partnership continues and not to rest upon indemnities with respect to what he has not contracted to engage in." Such is the original proposition; but the qualifications of it under which the minority must surrender to the majority are extremely important. Thus if the charter itself confers powers of consolidation they form part of the shareholder's accepted contract. If, as is usually the case, the State before the charter is granted has a general statute providing for consolidation, it also is accepted by the shareholder as part of the charter contract. A much more nebulous question arises when we come to the matter of legislative right, by the amendment and repeal power—under which practically all railroad charters have been granted—to so amend a charter as to force a dissenting shareholder into a consolidation by surrender of stock. In two cases in New England and one in New York it has been held that such amendment, if not a fundamental alteration in the charter, binds the shareholder as a conditional part of the original contract. On the other hand it has been held that the amendment concerns the contract between the State and the corporation, not that between the shareholders and that, as a result, a legislature cannot provide for appraisal and extinction of minority and dissenting shares. To quote from authority: "The contract which protects the dissenting holder from being unwillingly carried into a new venture will equally protect him from being unwillingly driven out of the old." But on this point of the scope of reserved and contingent right of amendment the rule of law is evidently unsettled.

As to the right of the State to condemn minority shares by its soveign power of eminent domain: The rule of law seems established and the power of the State to condemn is definitely affirmed in many decisions. But while, as a fundamental proposition, the power of the State to condemn minority—or, for that matter, majority—shares cannot be questioned, it is clear that the exercise of that authority should be exceedingly limited. The public necessity that demands it must be clear, positive, reasonably urgent and not uncertain, conditional or inferential. The power must not be exercised merely for the advantage or convenience of the absorbing corporation and upon that corporation the burden of proof to show the public requirement must rest. It is not enough

for the corporation to show that the merger will result in economy of operation, or simplicity of organization or reduced bookkeeping or somewhat improved service or even reduction of rates—for these latter are, indeed, practically almost as much within the power of the corporation that controls a subsidiary line as in the power of a corporation that condemns stock and merges. Above all it should be kept vividly in the foreground that the prerogative of eminent domain is the function of the State, not of the corporation, and that its application to personal property is peculiarly delicate not to say dangerous. Perhaps it is not going too far to add that the facts as to public benefit should be as clear as they are in condemning real estate. If, as seems likely, a considerable and increased number of cases involving condemnation of minority shares are to go to the courts hereafter, it seems probable that the judicial rulings will conform in substance to the foregoing views.

To summarize: (1) In the rapid evolution of the railroad merger we seem to be entering an epoch when the subject of the rights of majority and minority holders will come into large prominence in both legislatures and the courts. (2) In experience and fact both majority corporations and residuary holders too often abuse their vantages of position. (3) Outside of eminent domain the minority stockholder can in law resist successfully coercion but only when not confronted with adverse charter provisions, general statutes of consolidation and, it may be, the reserved legislative power of charter amendment. And (4) the minority stockholder cannot resist eminent domain; but the State should exercise that sovereign prerogative only with the utmost caution and in cases where public necessity and convenience are obvious and imperative.

February Accidents.

The condensed record of the principal train accidents which occurred in the United States in the month of February, printed in another column, contains accounts of 30 collisions, 24 derailments, and 3 other accidents. Those which were most serious, or which are of special interest by reason of their causes or attending circumstances, occurred as follows:

	Killed.	Injured.
2d—Findlay, Texas	3	1
†12th—Pennock, Minn.	3	1
*16th—Healy, Texas	..	..
20th—Jackson, Utah	24	13
*22d—Tehachapi, Cal.	..	..
†25th—Dyersville, Iowa	3	3

There appears to be no record of any passenger killed in a passenger train in February. The three persons killed at Pennock were passengers riding in the caboose of a freight train, and the Dyersville case was of the same kind. The combination of wrecks at Findlay is one of the rarest occurrences in train-accident annals. In all of the other three accidents in this short list, fires or explosions are the main features.

On February 3 a passenger train of the Canadian Pacific was derailed at Milford, N. S., on the Intercolonial, and most of the cars fell down a bank. Three passengers were reported killed and 15 passengers and trainmen injured. On the 9th the Canadian Pacific had a disastrous butting collision of passenger trains on its own line near Sand Point, Ontario, in which 8 passengers and 7 trainmen were reported killed and many others injured. The conductor and engineman of one of the trains held a meeting order which they disregarded.

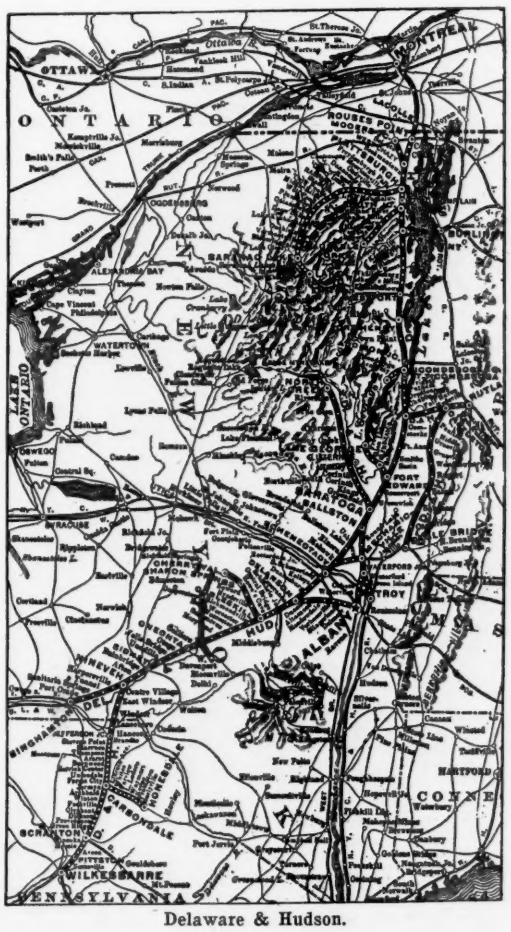
The number of electric car accidents reported in the newspapers of the United States in February was 25, in which three persons were reported killed and 112 were injured. Three of these accidents were collisions between passenger trains or cars and freight trains or cars, and there were five runaways.

A United States Senate bill, introduced by Senator Quay of Pennsylvania, asks for an appropriation of $50,000 for the purpose of "determining the quantity of the so-called hammer blow, centrifugal lift, and tangential throw of the counterbalance in locomotive driving wheels in use on American railroads, and also the effects produced thereby." It is proposed to divide this sum equally between the Franklin Institute, Philadelphia; Purdue University, Lafayette, Ind.; Philadelphia Commercial Museums and the University of Pennsylvania. According to press reports this bill has been introduced through the efforts of a Pennsylvania gentleman who has made yearly trips to Washington for the past 12 years in behalf of this pet measure. The bill has been referred to the Committee on Interstate Commerce. It is difficult to understand how $50,000 can be judiciously spent in investigating this subject unless it is proposed to pay expert mathematicians unusual fees for making the necessary calculations. Even then the results of these analyses can have no practical value, for every type of locomotive would require separate treatment. The magnitude of the disturbing forces in a locomotive depends solely on the weights and dimensions of the rotating and reciprocating parts and on the speed. These factors are all determinate and the resulting forces can be calculated. The institutions named can no doubt make good use of the money which it is proposed to appropriate and they can submit complete reports on the "quantity of the hammer blow," etc., and still have a considerable sum left to carry on more important investigations. But such indirect benefactions do not promote a high standard of ethics.

The bill which Representative Hearst, of New York, introduced in Congress March 11 to regulate interstate commerce has 16 sections and is No. H R 13778. It proposes the establishment of "The Court of Interstate Commerce," to consist of three justices, to receive $10,000 a year each; and a secretary, to receive $5,000. The court is to sit usually at Washington, but may hold sessions in any part of the United States. It shall have exclusive jurisdiction in matters brought by, or on the request of, the Interstate Commerce Commission under Section 3 of the act of February, 1903 (the Elkins bill); and exclusive and all necessary jurisdiction to enforce the interstate commerce law. Orders of the Interstate Commerce Commission may, within 30 days, be brought before this court for review. The decisions of the court shall be final, unless the court itself, or the Supreme Court, shall decide that there is a constitutional question which ought to be reviewed by the Supreme Court. The court may be applied to by the commission to enforce obedience to its subpœnas. Section 15 of the act makes it the duty of the Interstate Commerce Commission to proceed expeditiously in trying cases before it, and to render a decision within 60 days. The rest of this bill contains the provision which has been laid before Congress at previous sessions empowering the Interstate Commerce Commission, where existing rates have been found unreasonable, to fix rates for the future; also a clause requiring changes in tariffs to be published 30 days in advance, unless, on special application, the commission permits shorter notice.

Delaware & Hudson.

Gross earnings for the year ending Dec. 31, 1903, were $13,642,953, as against $11,050,690 in 1902, an increase of $2,592,263, comparing with an increase of $1,480,046 in operating expenses, to a total of $8,169,196, leaving net earnings from operation, $5,473,757, as against $4,361,540 in 1902. Earnings from the coal properties, following a year when but little coal was mined, were of course very great, aggregating $24,588,623, including miscellaneous receipts, as against $14,271,388 last year, and total gross earnings



Delaware & Hudson.

of the coal and railroad properties combined amounted to $34,186,371. Net earnings from all departments aggregated $6,389,709, as against $2,642,782 the year before, and after charging off sundry accounts and a sinking fund appropriation, $3,914,794 was carried forward to profit and loss as net earnings. Seven per cent. dividends were paid from this, aggregating $2,450,000, and $1,000,000 was charged for equipment; $284,243 for new railroad construction and $188,634 for coal breakers, washeries, etc. The total expenditure for betterments against depreciation, charged to operating expenses and general profit and loss, during the year, was $3,963,471. No addition was made during the year to any of the company's capital accounts except that of equipment. The additions to this account aggregated $1,624,193, against which $1,288,659 was charged off, making a net increase amounting to $335,534 in the equipment account; but during the year $610,000 of debentures were paid and 1,000 shares of stock were purchased for the sinking fund and canceled, so that offsetting the equipment increase, the outstanding capitalization of the property has been diminished by $710,000.

As was to have been expected, the chief railroad gain of the year was in the transportation of coal, which amounted to over 52 per cent. of the total freight, as against about 44 per cent. last year, and aggregated $5,585,774, an increase of nearly two millions. Grain and manufactured articles also showed a good increase during the year, however, and passenger traffic increased from $2,673,176 to $2,810,594. Apart from the coal traffic, unclassified manufactures showed the most important traffic gain, the increase amounting to nearly 90,000 tons, or 12 per cent., while grain increased 73,048 tons, or 33 per cent. Nearly twice as much anthracite coal was carried in 1903 as in 1902, and the bituminous traffic also increased largely.

During the year, 103 miles of road were added to the lines by purchase of the Cooperstown & Charlotte Valley and lease of the Chateaugay & Lake Placid. Work of standard gaging the latter was practically completed in 1903, at a cost, thus far, of $1,786,299. Of this, $1,500,000 has been paid from the proceeds of a temporary loan and the balance from current income. Since the close of the year the directors have decided upon an issue of $7,000,000 new stock, pending action by the stockholders, which will pay for this improvement and also for $344,000 underlying bonds upon the Chateaugay & Lake Placid property and for the $5,000,000 bonds and debentures of the New York & Canada Railroad, guaranteed by the Delaware & Hudson, which fall due May 1, 1904.

Although quite full statistics of operation are included in the report, the form of the presentation of some of the accounts leaves much to be desired, chiefly owing to a lack of unity of method in reporting the affairs of the constituent companies. The chief figures of operation and income are as follows:

	1903.	1902.
Mileage worked	821	718
Income, coal and sales dept.	$20,153,231	$11,064,748
Gross earnings, R. R. dept.	13,642,953	11,050,690
Freight earnings	10,690,700	8,244,282
Passenger earnings	2,810,594	2,673,176
Total expenses	8,169,196	6,689,150
Maint. of way and structures	1,577,746	1,354,080
Maintenance of equipment	1,386,187	1,243,637
Conducting transportation	4,564,753	3,720,116
Net income, D. & H. Co. (after $184,552 charged to sink. fund)	3,914,794	...
Net income (after $144,907 charged to sinking fund)	...	2,497,875

Texas & Pacific.

With 1,827 miles of track located in the Southwest, this company reflects to a considerable extent the existing industrial conditions in this section. During the year ended Dec. 31, 1903, however, more than the usual share of cotton was carried. Although the states of Texas and Louisiana raised less cotton in 1903 than in 1902, the actual number of bales carried by the Texas & Pacific was 850,788, as against 773,082 in the previous year, which yielded the company a revenue of $1,112,534, as compared with $1,042,399 in 1902. This increase in revenue was also marked in the line of agricultural products carried, but was partly offset by a heavy loss in the traffic of manufactures and merchandise, which showed a falling off of 141,894 tons. Notwithstanding this, total freight earnings for the year increased $737,548. At the time of the report, the cotton growth for 1904 bid fair to be a good one, owing to the general shortage in 1903 and to the large advance in prices, which would naturally induce the cultivation of a much larger area.

Gross earnings in 1903 were $12,094,744, as against $11,236,601 in 1902, and earnings per mile of road were $7,003, as compared with $6,621. Operating expenses increased $533,816, and net earnings increased $324,327, as against a decrease in the net earnings of $251,180 in 1902. Cost of conducting transportation accounted for most of the increase in operating expenses. At the close of 1902 President Gould stated that "the heavy disbursement required during the year in the improvements and extensions of the company's lines in Louisiana and Texas and in improving the efficiency of its equipment created a temporary floating debt which will be reduced, if not entirely liquidated, during the coming year." Instead of this, at the end of the year the floating indebtedness had increased $465,413.

Action was taken by the directors, Feb. 8, to correct this by passing the interest on the second mortgage income bonds, and devoting the funds thus released to reduction of the floating debt. But the action was rescinded a few days later, and the regular 5 per cent. dividend ordered paid when it fell due, in March. A very large majority of these income bonds are owned by the St. Louis, Iron Mountain & Southern.

The statistics for 1903 show an increase in the average carload and trainload. The average number of loaded cars in each train remained the same, but the average carload increased from 12.7 tons to 13.4 tons and the average trainload from 191.4 tons to 206.8 tons; gains due directly to recent expenditures for heavier equipment and for betterment of the lines during 1901 and 1902. The branch lines in Louisiana, which have been under construction for three years, were completed in December, 1903. These comprise a total of 340 miles and connect the Port Allen branch with the New Orleans & North-

eastern and the St. Louis Valley Ry. The cost of the branches has been met to the extent of $12,500 per mile by an issue of Louisiana Division Branch Lines First Mortgage bonds. The principal statistics of operation were as follows:

	1903.	1902.
Average mileage worked	1,727	1,697
Gross earnings	$12,094,744	$11.236,601
Freight earnings	8,504,462	7,766,914
Passenger earnings	2,494,545	2,557,896
Total operating expenses	8,286,106	7,752,290
Maintenance of way	1,518,098	1,560,617
Maintenance of equipment	1,395,265	1,410,593
Conducting transportation	5,011,663	4,423,021
Net earnings	3,808,638	3,484,311

NEW PUBLICATIONS.

Facts About Railroad Bonded Indebtedness. A supplement to Poor's Manual of Railroads, issued by Poor's Railroad Manual Co., 68 William street, New York. January, 1904.

This supplement of 94 pages is of considerable value in that it assembles in a condensed space the chief facts about outstanding railroad bonds. Cross references are constantly made to Poor's Manual wherever it is necessary to enter into a longer discussion about an issue of bonds than there is room for in the supplement, but the latter serves a useful purpose as a time-saver when it is desired to find at once the main facts about an issue. At the end of the pamphlet is a careful index of all bonds described in the ready reference list.

TRADE CATALOGUES.

National Paint Works, Williamsport, Pa., has published in pamphlet form a second review of technical paints for the protection of metal surfaces. The last review was published three years ago and it contained in condensed form the results of the most important tests made by manufacturers, consumers and independent investigators up to that time to determine the most satisfactory paint for the protection of metal surfaces and much other valuable information about the composition and mixing of protective paints. This second review brings the former compilation up to date and includes the results of many practical and convincing tests and experiments made in laboratories and in actual service during the last three or four years. The last few pages contain a brief description of a number of the standard products of the National Paint Works and some suggestions for their use on different kinds of structures exposed to smoke, acid fumes, salt spray and other active corrosives.

The Denver, Northwestern & Pacific (Moffatt Road) has issued two interesting and instructive pamphlets, one being a report concerning the Yampa coal fields of Routt County, Colo., and the other a report on the hydrocarbon field of western Colorado and eastern Utah, both regions being on the projected line of the road. The reports are by Mr. W. Weston, M. I. M. M., Mining Engineer, and are made to Vice-President and General Manager Ridgway. Both reports contain valuable information which is illustrated by a large number of excellent full-page half-tone engravings from photographs. Each pamphlet contains in a pocket on the inside of the back cover a special map of the region discussed, prepared by the author of the reports.

The India Rubber & Gutta Percha Insulating Co., Yonkers, N. Y., issues a catalogue 8 in. x 10½ in., illustrating the "Habirshaw" insulated cables for telegraph, signaling and other electric uses. Full size half-tone illustrations are given of the different sizes and makes of cables, containing conductors arranged in all sorts of ways. There are also views of the testing apparatus used in the company's shops. The increased use of high tension currents makes testing more and more important year by year, and the company has provided complete appliances for this work. Cables for signaling purposes made by this company are used by the New York Central, the Lehigh Valley, the Pennsylvania, the Lackawanna and the Illinois Central.

Wyman & Gordon, Worcester, Mass., makers of all kinds of drop forgings, publish monthly in pamphlet form instead of a catalogue a brief biographical sketch of the great engineers of the past. They are interesting and accurate and the whole set makes a valuable little library of engineering achievements. The March, 1904, issue contains an account of the life and work of Thomas Newcomen, who did much to perfect the steam engine before the time of James Watt. These little books will be sent on application.

B. F. Sturtevant Co., Boston, Mass., has just issued a condensed catalogue of its more important products, including steel-pressure blowers, exhausters, galvanized iron work, countershafts, disk and propeller fans, engines, dynamos, forges, motors, steam-heating, ventilating and drying apparatus, steam traps and industrial equipments. Complete tables are given of the principal dimensions of the various machines, including sizes, weights and prices.

The Consolidated Pneumatic Tool Co., Ltd., Westminster, London, S. W., has published a comprehensive catalogue of its different kinds of pneumatic hoists, drills, hammers and riveters. The catalogue contains a supplement fully illustrated with photographs of the various tools at work. Complete tables of dimensions, weights and sizes are also given, with a short description of the more important tools.

The Republic Railway Appliance Company, St. Louis and Chicago, issue a pamphlet showing Republic friction draft-gear as applied to all classes of freight equipment. There are engravings from wash drawings, showing sections and detail parts of the gear, and also a number of plates from line drawings, showing the different applications of the gear.

Exhibits at the Maintenance of Way Convention.

The exhibits at the Engineering and Maintenance of Way Association convention at Chicago were placed on the parlor floor of the Auditorium Hotel, as in former years. The number of exhibitors was much larger than in any previous year, crowding the exhibit space to the utmost. At the present rate of increase additional exhibit space will have to be found for next year's convention. A list of the exhibitors follows:

Affleck Concrete-Steel Tie Co., Chesterton, Ind.—Samples of concrete-steel ties.

American Asphaltum & Rubber Co., Chicago.—Samples of waterproof roofing material and rubber cement.

American Frog & Switch Co., Hamilton, Ohio.—Adjustable reinforced split switch and reinforced hinged-wing spring frog.

American Hoist & Derrick Co., St. Paul, Minn.—Photographs of cranes, hoists and hoisting engines.

American Hydraulic Stone Co., Denver, Col.—Samples of hollow concrete blocks for building purposes.

American McKenna Process Co., Milwaukee, Wis.—Samples of rail sections of various sizes before and after renewing by the McKenna process.

American Nut & Bolt Fastener Co., Pittsburg.—Samples of Bartley nut and bolt fasteners.

The American Track Barrow, Lowell, Mass.—Models of American track barrow, timber dolly and pony car.

American Water Softener Co., Philadelphia.—Model of water softening plant by Brunn-Lowener system; also illustrative literature.

American Valve & Meter Co., Cincinnati, O.—Full-size Poage automatic water column, style D, and samples of "Little Giant" switch-stand.

W. H. Anderson & Sons, Detroit, Mich.—Sample improved rail wrench.

Armspear Mfg. Co., New York.—Standard Armspear semaphore and switch lamps.

Arnold Electric Power Station Co., Chicago.—Plates showing power stations installed for various railroads; also descriptive matter.

E. C. Atkins & Co., Indianapolis, Ind.—Poster illustrating Atkins saws.

Atlas Railway Supply Co., Chicago.—Samples of Atlas compromise joint, Atlas rail brace and Atlas tie plates.

Barker Mail Crane Co., Clinton, Iowa.—Model of Barker mail crane and full-size spring for same; also appliance for placing mail sack.

Barschall Impregnating Co., New York.—Models of Barschall rail joint and double-web rail; also pamphlets entitled "A Treatise on Wood Preservation."

Belle City Malleable Iron Co., Racine, Wis.—Samples of L. & S. anti-rail-creeper and joint tie holders.

F. W. Bird & Son, East Walpole, Mass.—Samples of Paroid roofing and hydrox waterproofing. Photographs showing application.

J. A. & W. Bird & Co., Boston and Chicago.—Samples of Flintkote roofing and full-size magnite spray pump.

Bond Steel Post Co., Adrian, Mich.—Galvanized steel, right-of-way signs and the Bond post.

Broderick & Bascom Rope Co., St. Louis.—Large exhibit of wire switch ropes and railroad tackle blocks and sheaves. Catalogues and printed matter.

Buda Foundry & Mfg. Co. and Paige Iron Works, Chicago.—Full-size oscillating cattle guard, Ramapo switch-stand connected with automatic derail, Buda hand and push car wheels, rail benders, Buda tie-plate gage, McMann track gage and level, and Paulus track drill.

Cambria Steel Co., Pittsburg.—Sample 100 Per Cent. rail joint.

H. Channon & Co., Chicago.—Samples of shovels, jacks and general railroad track supplies.

Chicago Steel Tape Co., Chicago.—Samples of steel tapes.

Climax Railway Supply Co., Chicago.—Full-size Union Drop Forge Co. claw bar, Edgar car lock and seal, Climax fence posts, Climax signal posts and miscellaneous track tools.

Climax Stock Guard Co., Canton, Ohio, and Chicago.—Samples of full-size sections and model of the Climax vitrified clay cattle-guard.

Columbus Steel Rolling Shutter Co., Columbus, Ohio.—Full-size working model of steel rolling door for 2½ ft. x 3½ ft. doorway. Model of fire door equipped with fuse, for release by heat.

Cortwright Metal Roofing Co., Philadelphia.—Model showing samples of Cortwright metal roofing.

Coughlin-Sanford Switch Co., New York.—Sixteen-foot working model (one-fifth size) showing the Coughlin swing-rail frog in connection with split switch protected by the Coughlin-Sanford point lock.

Dayton Malleable Iron Co., Dayton, O.—Samples of track wrenches, rail benders, track-gage ends, torches, ground switch latches and rail shims.

Paul Dickinson, Chicago.—New models of roundhouses equipped with Dickinson movable telescoping smoke-jacks and overhead traveling crane.

Dilworth, Porter & Co., Ltd., Pittsburg.—Samples of Goldie claw tie plate, Glendon flange tie plate and spikes.

Dormant Sod Co., Union Stock Yards, Chicago.—Samples of Dormant sod growing and packages of the sod ready for shipment.

Eastern Granite Roofing Co., New York.—Samples of "Eastern" granite roofing.

Edison Mfg. Co., Orange, N. J.—Samples of Lalande primary batteries.

The Eyeless Tool Co., Newark, N. J.—Samples of eyeless track tools.

Fairbanks, Morse & Co., Chicago.—Catalogues, pamphlets and photographs of pumping engines and machinery, oil and gasoline engines, locomotive coaling stations, Barrett jacks, Sheffield hand car, pressed-steel wheel and Buckeye lights.

Foos Gas Engine Co., Springfield, Ohio.—Catalogues and circulars describing Foos gas and gasoline engines.

The General Manifold Co., Franklin, Pa.—Samples of manifold forms for the engineering and maintenance of way departments.

Wm. Goldie, Jr., & Co., Pittsburg.—Samples of the Goldie perfect tie plug.

Hall Rail Joint Co., Chicago.—Samples of the Hall boltless rail joint.

Hill's Automatic Railway Switch, Elyria, Ohio.—Model of automatic switch.

Holme Continuous Rail Forging Co., Pittsburg.—Full-size Holme forged rail joints.

Hubbard & Co., Pittsburg.—Track tools, picks, mattocks, etc.

Hussey-Binns Shovel Co., Pittsburg.—Samples of shovels, spades and scoops.

Illinois Malleable Iron Co., Chicago.—Model of Bruyn automatic swinging smoke-jack and blueprints.

Improved Rail Joint Co., Rochester, N. Y.—Model of "Improved" rail joint.

Independent Railroad Supply Co., Chicago.—Wolhaupter compromise rail joints and Wolhaupter rail joints of various styles; Federal tie plates and shoulder and fixed claw tie plates.

International Creosoting & Construction Co., Galveston, Texas.—Piling in use in Galveston bay 28 years, railroad tie from City of Mexico in use 5½ years, paving blocks from Galveston in use 28 years and large assortment of pine treated with various preservatives.

Wm. R. Jacques, Kansas City, Mo.—Model application and operation of K. and K. car blocker and derailer.

Kennicott Water Softener Co., Chicago.—Thirty-two large photographs showing Kennicott water softening plants on railroads throughout the country, exhibited by a mechanical revolving sign.

Keuffel & Esser Co., New York.—Samples of steel and metallic tapes, surveying instruments, mining transits and railroad levels.

Kinnear Mfg. Co., Columbus, O.—Working model of steel rolling door. Photographs showing installations; sections showing construction. Also copper rolling door for roundhouses.

A. Leschen & Sons Rope Co., St. Louis.—Wire switch ropes, wire and manilla rope, tackle blocks; samples of all grades of wire rope made by this company, including the patented flattened strand and "Hercules" brand. Also wire rope fastenings of many kinds.

Lidgerwood Mfg. Co., New York.—Photographs of hoisting engines and the Lidgerwood rapid unloader.

Link-Belt Machinery Co., Chicago.—Large photographs of locomotive coaling stations.

Lufkin Rule Co., Saginaw, Mich.—Exhibit of steel, linen and metallic tapes, chain tapes and steel scales.

McClintock Mfg. Co., St. Paul, Minn.—Working model of telegraphic automatic block signal, giving telegraphic communication between moving trains and between moving trains and stations.

McCord & Co., Chicago and New York.—Model Gibraltar bumping post.

Mann-McCann Co., Chicago.—Model showing Ravelin system of electric-wired roundhouse; also photographs of McCann ballast spreader car.

Mahoney Railroad Ditching Machine Co., Vincennes, Ind.—Model of railroad ditching machine.

Morden Frog & Crossing Works, Chicago.—Small model of double slip switch with movable points controlled by one stand with four-way movement. Samples of Duplex guard-rail clamp, adjustable open-side switch socket, and Union track jack. Also the new Security switch stand for operating distant signal and non-breakable automatic ground-throw stand.

National Coal Dump Car Co., Chicago.—Photographs and descriptive matter of National coal dump car.

National Fireproof Paint Corporation, Chicago.—Cans of the National paint, photographs showing test, etc.

National Lock Washer Co., Newark, N. J.—Samples of lock washers.

New Castle Forge & Bolt Co., New Castle, Pa.—Samples of track bolts, brake jaws, rivets, chains, bars, etc., and descriptive literature.

New York Continental Jewell Filtration Co., New York and Chicago.—Photographs showing water softening plants in various parts of the country.

George P. Nichols & Bro., Chicago.—Photographs of turntables and transfer tables.

Northern Engineering Works, Detroit, Mich.—Catalogues and circulars describing traveling cranes, trolley and air hoists.

Oliver Iron & Steel Co., Pittsburg.—Samples of track bolts, tie plates, machine bolts, anti-creeper device and rolled-thread-drive track spikes.

Spencer Otis Co., Chicago.—Samples of Hart tie plates.

Otto Gas Engine Works, Chicago.—Photographs and drawings of Snow-Moore water crane, gas engines and gasoline-engine operated coaling stations; also photographs of Davidson water softening plants throughout the country, and bridge turning machinery.

Park Mfg. Co., Chicago.—Small working model, in operation, of the Park automatic loader. Photographs, blueprints and circulars.

Pennsylvania Steel Co., Philadelphia.—Small models of spring rail frog, split switch, reinforced split switch with adjustable connecting bar, anvil-face frog, New Century adjustable switch-stand, Challenge switch adjustment, Long safety switch-stand, Acme rail brace, switch socket; also locking device for switch points on main line track.

Positive Lock Washer Co., Newark, N. J.—Represented by Ward Railway Supply Co., Chicago.—Samples of lock washers.

Pyle-National Electric Headlight Co., Chicago.—Full-size model in operation showing the Commercial Acetylene Company's safety storage system of acetylene gas lighting.

Railroad Supply Co., Chicago.—Samples and models of two—T. W. and Wolhaupter—tie plates; sections of tie plates; signal apparatus and the Chicago crossing alarm.

Railway Appliances Co., Chicago.—Full-size model of the

Bonzano rail joint, Fewings car replacer, Q & C portable rail saws, Q & C metal sawing machines, R-A car movers, Q & C Samson rail benders, track drills, etc.

Ramapo Iron Works, Hillburn, N. Y.—Working models of automatic safety switch-stand, McPherson safety switch and frog and full-size safety switch-stand fitted with automatic lock.

Rand Drill Co., New York.—Drawings and catalogues of air and gas compressors, photographs of Imperial air compressors, and an exhibit of pneumatic hammers, drills, etc.

Raymond Concrete Pile Co., Chicago.—Catalogues, photographs and model showing the Raymond concrete pile system, and photographs showing work being done in various cities.

Richardson Scale Co., New York and Chicago.—Small working models of automatic scales for weighing coal, grain, cereals and any free flowing material.

Roberts Car & Wheel Co., Three Rivers, Mich.—Full-size Donoran pressed-steel hand and push car wheel made without rivets or bolts.

Rodger Ballast Car Co., Chicago.—Views showing sections of Hart convertible, class G S cars, and photographs showing work done on the Rock Island and St. Louis & San Francisco with Hart convertible cars, center and side dumping. Also pamphlets illustrating 50-ton steel underframe car.

Roemheld & Gallery, Chicago.—Photographs and blueprints showing Strauss' trunnion bascule bridge.

Ross Impassable Cattle Guard Co., Powderly, Ky.—Full-sized section of the Ross metal surface cattle guards. Photographs and testimonials.

St. Louis Expanded Metal Fireproofing Co., St. Louis.—Models of a reinforced concrete arch and of an abutment; transparencies showing steel-concrete structures built for various railroads; records of tests of reinforced concrete beams; samples of corrugated bars and literature describing steel-concrete structures and giving tables for designs of beams, floors, etc.

Scherzer Rolling Lift Bridge Co., Chicago.—Large and small albums of photographs of Scherzer rolling lift bridges.

Spaulding Print Paper Co., Inc., Boston.—Catalogues showing the Federal blueprinting machines.

Standard Paint Co., New York.—Samples of Ruberoid roofing for buildings and samples of P. & B. and Giant insulating papers.

Trussed Concrete-Steel Co., Detroit, Mich.—Kahn system of reinforced concrete showing full-size bars. Drawings showing the application to different types of railroad structures, including culverts, bridges and buildings; also photographs and printed matter.

Variety Mfg. Co., Chicago.—Working model of cross horizontal folding door and cross freight elevator door.

Western Roofing & Supply Co., Chicago.—Model of building covered with Carey's roofing flexible cement.

C. H. Whall & Co., Boston.—Samples of fiber insulation and models of rail joints showing application of fiber insulation.

Whiting Foundry & Equipment Co., Harvey, Ill.—Photographs showing electric traveling cranes.

New Automatic Block Signals on the Southern Pacific.

The plans of the Southern Pacific Company are for the equipment during the present year of 154 miles of its single track lines with automatic block signals. A diagram showing the arrangement of the electric circuits on about 10 miles of the main line in Nevada is shown in the drawing. The total length of the installation on this division is 19 miles, from Valley Pass eastward to Montello. The diagram shows three passing stations, enough to make clear the arrangement of circuits at all stations. The grade of the line here shown is uniformly descending eastward. Distant signals are provided at the approaches to all stations for eastbound trains, but none for westbound. Where signals are required between meeting points the eastbound and westbound posts are set some distance away from one another, instead of being exactly opposite, as in the plants installed by this company in 1901. The distant signal takes the place of the overlap and enables a waiting westbound train to occupy the main track up to the fouling point of the switch nearest to the home signal, without holding back the train which is coming from the opposite direction. This avoids delay to trains which are approaching a station from opposite directions with orders to meet one another with the least possible loss of time. Where a block section is so long that more than one track circuit is required, the signal wire, strung on the telegraph poles, is broken through the contact points of the relay in each track section, and there is no relaying of one track circuit into another.

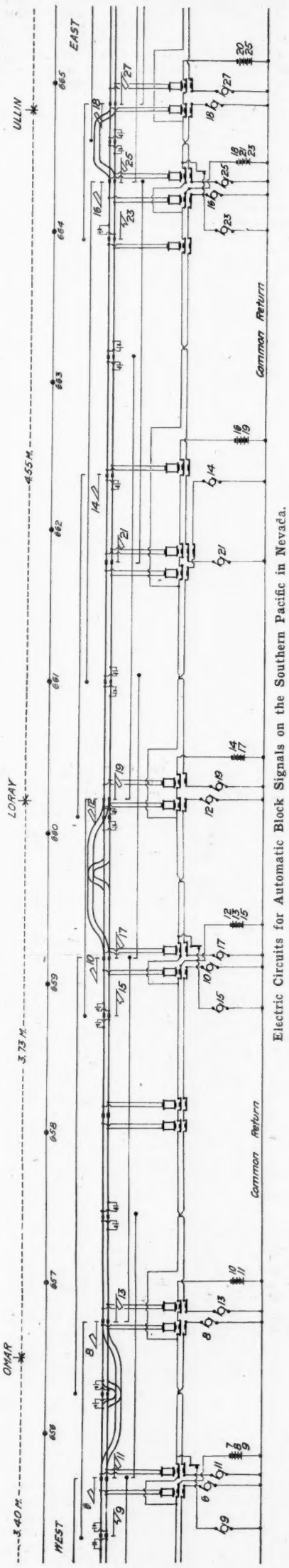
The long straight lines on the diagram which terminate in a heavy dot, indicate the length of track controlled by each signal. For example, the line leading from signal No. 10 westward extends to the insulated joint near the middle of the side track at Omar. As soon as a train going east passes this joint, signal No. 10 goes to the stop position. The train being then 2,500 ft. short of signal No. 13 has the benefit of an overlap of that length. If a westbound train should pass signal No. 10 at the same instant that an eastbound train passed the insulated joint just mentioned, the eastbound train would find signal No. 13 against it.

The distant signal current is controlled by the circuit breaker at the home signal, as indicated in the diagram of wires and by contact points in the track relays.

The complete list of the lines to be equipped with automatic signals this year by the Southern Pacific is as follows:

	Miles.	
Salt Lake Division—		
Ogden-Lucin cut-off—Crossing Great Salt Lake	33.8	
Valley Pass to Montello	18.6	
Wells to Moor	8.7	
Three tunnels between Osino and Elburz	3.5	
		54.6
Sacramento Division—		
Truckee to East Reno	38.2	
Elvas to Sacramento—Double track	3.3	
		41.5
Western Division—		
Oakland to Port Costa—Double track	25.7	
		25.7
In Oregon—		
East Portland	.3	
		.3
In Texas—		
Englewood to Crosby	16.1	
Dayton to Ames	9.1	
		25.2
In Louisiana—		
Berwick to Bayou Sale	14.9	
Salix and Boutte to Des Allemands	10.6	
		25.5
Total		182 8

In Texas and Louisiana semi-automatic signals are to be put in at drawbridges interlocked with machinery operating the draw, at Trinity, Neches, Buffalo Bayou, Clear Creek, Dickenson Bayou, Berwick Bay, Boeuf, Lafourche Calcasieu, Sabine, Des Allemands and Mermentau.



Electric Circuits for Automatic Block Signals on the Southern Pacific in Nevada.

Steel in Car Construction.

The paper of Mr. C. A. Seley on this subject, presented to the Western Railway Club March 15, was printed in these columns last week.

Mr. Schroyer (C. & N. W.) found serious objections to steel cars, in that steel car construction is encumbered with patents; and a road cannot build the cars complete in its own shops, because of these patents. He gave prices of steel cars as from $1,300 to $1,800, while wooden cars can be built for about one-half, so that on a lot of 1,000 cars, the difference in cost would enable another 1,000 wooden cars to be built, the earnings of which would be more than half enough to maintain the entire car equipment of the North Western system—about 54,000 cars. No road is justified in buying steel cars except of the highest capacity—80,000 to 100,000 lbs.—and since the average loading of cars is far under their capacity, the loss in revenue is relatively greater with these high-capacity cars. The purchase of such cars is justified if maximum loads can be obtained at all times as in the case of ore cars. Such cars, however, are open to the serious objection that the load is concentrated on a wheel-base of 18 to 20 ft. This gives too heavy a loading for many bridges, and furthermore the center of gravity of the car is so high as to produce objectionable results. Two 80,000-lb. wooden cars under the usual conditions of service will earn much more money than a single steel car while costing very little more. He said the interest at 6 per cent. on the first cost of steel cars was nearly double the cost of maintenance of wooden cars.

Mr. Hennessey (C. M. & St. P.) recommended all-steel construction for only 100,000-lb. self-cleaning hopper coal cars. The C., M. & St. P. now has in service a number of wooden cars with metal center sills, and is building 500 more coal cars of 100,000 lbs. capacity of similar design. He does not consider the metal car a good investment for Western roads at the present time. To compare deterioration of wooden box cars and steel frame box cars the side and center sills only should be considered, as deterioration at other vital points—roof, floor, siding, etc.—will be about the same in the two. The life of side sills for wooden cars is from 15 to 20 years, but steel sills have not been in service long enough to determine the life.

Mr. Stimson (Swift & Co.) said that, considering first cost, interest, depreciation, and the fact that refrigerator cars hardly ever carried more than 30,000 to 40,000 lbs., that a steel car would have to last something like 75 years to compare with the present wooden refrigerator car; and it would also have to earn nearly double the amount per year of the wooden car.

Mr. William Forsyth said that the economy of the high-capacity car had been demonstrated and therefore the steel car should be an economical one. The figures for repairs and also for cost of steel cars given by Mr. Schroyer were questionable and his opinion was that $800 would be much nearer the right figure. In referring to present designs of cars he said the body bolster now generally used is probably the most uneconomical feature about the car. Attaching wood to steel in passenger car construction has proven a difficult and awkward thing, but it appears to have been done successfully in Europe.

In reply, Mr. Seley said that on the Norfolk & Western the building of the 100 steel-frame box cars spoken of in the paper was immediately followed by 400 wooden cars of the same capacity, same trucks and same general dimensions. The latter cost only about $140 less than the steel-frame cars. This was in a locality close to the Southern timber market, and involved quite a haul of the steel material from Pittsburg. Had the cars been built nearer the source of the steel supply, this difference would have been reduced so far that it might have been disregarded.

He was convinced that steel would effect economies in both maintenance and repairs. Taking a case of a thoroughly wrecked car, such as would result from rolling down the side of a mountain. The car would be taken to the shops, the bent sections straightened and re-riveted, the woodwork renewed as required, and the whole repainted and re-stenciled for an average cost of $138 for a 50-ton hopper car. A wooden car after such an experience would be burned and nothing saved but the scrap. An analysis of this cost shows about 76 per cent. for labor and the balance for material. With wooden equipment this relation is reversed.

The Hydraulic Lock on the Trent Canal at Peterborough.

BY WALTER J. FRANCIS, *C. E., M. Can. Soc. C. E.*

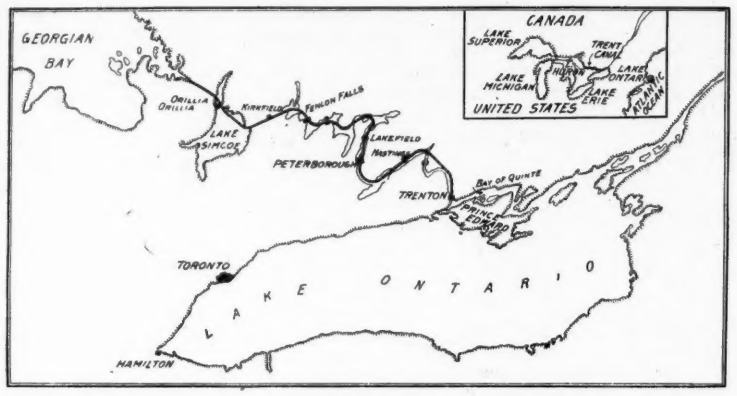
The Trent waterway consists of a series of lakes and rivers connected by artificial canals. It is intended to form a connecting link between Midland Harbor, at the southern end of Georgian Bay, and Trenton, on the Bay of Quinté, which leads to Lake Ontario. This waterway, which has been under contemplation for a number of years, and which was originally selected by the Royal Engineers of England as the most practicable route between the Upper Lakes and the Seaboard, is now being pushed forward by the Government of the Dominion of Canada. Several contracts have been let and many completed during the last eight years. Of the total length of 203 miles, only about 25 require to be completed to furnish navigable water throughout the whole distance. Leaving Midland Harbor, where there is a depth of about 20 ft. of water, the route is intended to be by way of the River Severn into Lake Simcoe. From Lake Simcoe, through the valley of the Talbot River, Balsam Lake is reached, thus giving access to a chain of magnificent lakes, many of which equal in grandeur of scenery the lake of the Thousand Islands. Leaving this chain of lakes the route enters the River Otonabee, better known at its lower end as the Trent, passing through the city of Peterborough into Rice Lake, and thence to the Bay of Quinté. The whole of the route passes through a fertile and progressive part of the Province of Ontario, and will be of immense benefit to the inhabitants of these parts. Many towns of considerable size and importance are located along the waterway. The chief importance of the canal, however, is thought to be its value for barge navigation, permitting grain to be brought in large vessels from the west to Midland, here breaking bulk and unloading into barges, which will be towed in lines of from two to six over this new waterway, down the St. Lawrence to the ocean vessels at Montreal. (See map of canal.)

The hydraulic lock is located in a section of four miles of canal which has been built to overcome the obstructions to navigation found in the River Otonabee, where it passes through the city of Peterborough and where there are many water powers in use for manufacturing purposes. The total difference in elevation in this section is 77 ft. After leaving the river at the upper end of the section, about 3½ miles of canal is formed by short lengths of excavation and natural valleys until the slope of a hill is reached, where a difference in elevation of 65 ft. is found in a distance of about 800 ft. Here the hydraulic lock is located and the difference in height overcome in one lockage. About a quarter of a mile farther the remaining 12 ft. of height is taken by a lock of the ordinary type which leads again into the natural waters.

Placing a Section of One of the Main Rams.

The hydraulic lock is, theoretically, an automatic machine, and is designed to take the place of ordinary locks, where great differences in elevation are found in a comparatively short distance. Already three of these locks are in operation, one being in England, another in Belgium and a third in France. The English lock has been in continuous operation for over 30 years, while the other two have been completed about 10 years. The Peterborough lock is now ready for the operating test, which will be carried out on the opening of navigation in a few months. The European locks have a lift of about 50 ft. The Peterborough lock has a lift of 65 ft. The depth of water in the French and Belgian locks is 7 ft. 10 in. and the lock chambers are 140 ft. long and 19 ft. wide. Several others having similar dimensions are being built by the Belgian government. The chief dimensions of the Peterborough lock are 65 ft. lift, chambers 140 ft. long, 33 ft. clear width and 8 ft. normal depth of water.

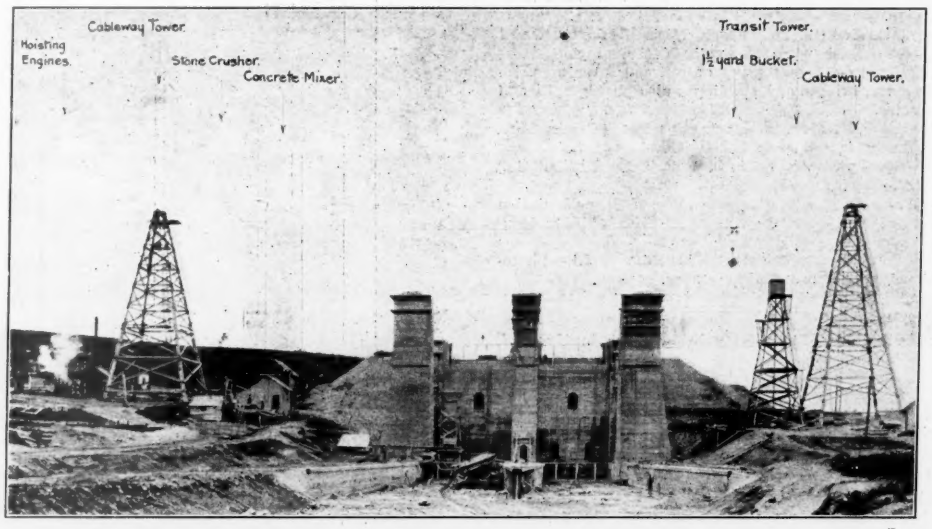
In principle the hydraulic lock may be likened to two immense hydraulic elevators having their presses connected together, the descending one furnishing the power which causes the ascending one to rise. The platform of each elevator is made in the form of a large watertight box or tank closed at either end by a gate. The upper and lower reach of the canal are each formed into two branches, corresponding to the ends of the boxes, and each branch is closed at the end by a gate. The lockage is performed by towing the vessel into the box of water and then closing the gate on the end of the box as well as that of the canal, thus leaving the box independent of the reach and free to move vertically. The box, with the water and the floating vessel, is then raised or lowered to the other reach. The chamber or box about to descend is loaded with a few inches more water than the other chamber, thus giving it the necessary additional load or "surcharge" to enable it to cause the ascending chamber to rise when water communication is established between the two presses. The construction of the Peterborough lock varies materially from the others that have been completed, and as far as outward appearance is concerned there is little similarity. The departures are largely due to the different practices adopted by American and European engineers in steel construction.



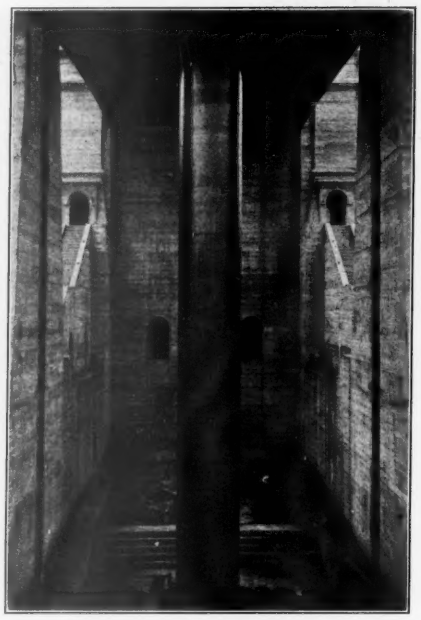
Map of the Trent Canal—Hydraulic Lift Lock at Peterborough.

A gradual slope was selected for the site of the lock. The excavation was completed in 1899. The location was chosen so that an average depth of excavation of about 40 ft. was required, and the material thus obtained was used in building embankment to carry the level of the upper reach to the back of the structure. The excavated material was found to be hard clay mixed with small stones and boulders, underlying a thin layer of fertile soil. At the upper end of the excavation, which was the deeper, a small amount of hardpan was encountered, and below this a shaly limestone rock. The rock was in layers of from ½ to 8 in. in thickness, between which were thinner layers of clayey and shaly material. The layers of crystalline limestone stand the weather quite well, but the shaly parts disintegrate very rapidly under the action of rain and frost. The elevation at which rock was found was exceedingly fortunate, being practically at the level of the bottom of the pits. After being cleaned up less than 2 ft. of concrete brought the floor to its proper grade. No footings were provided under any of the walls, all being built upon the solid rock.

The wells in which the large presses stand were excavated about 75 ft. below the floor of the pits, the diameter of the rock excavation being 16 ft. 6 in., and the nature of the rock rendered this work comparatively easy. In the bottom of each well there is a foundation of granite, the reason for which will be quite apparent since the whole weight of the lock chamber and its burden is concentrated on the bottom of the press and from there distributed over the rock. The granite blocks composing the foundations were 29 in. and upwards in thickness, and were arranged in three courses all well bonded, as will be seen by reference to one of the accompanying illustrations. After the granite work was finished the wells were lined with concrete about 14 in. thick, bringing the diameter to 14 ft. 2 in. No great difficulty was experienced from water, but in order to render the concrete linings as tight as practicable the water was allowed to follow close up to the finished work, thus balancing the back pressure and saving the new concrete from being scoured before setting. This method proved quite satisfactory, and during the placing of the presses the linings were found to be quite watertight.



General Arrangement of Concreting Plant—Hydraulic Lift Lock on the Trent Canal.



One of the Main Lifting Rams.

The substructure of the lock is built entirely of concrete and contains over 26,000 cu. yds. For purposes of description the substructure may be divided into (a) the breast wall and wings, which serve as retaining walls for the upper reach; (b) the side walls, being the retaining walls for the earth along the sides of the lock; (c) the towers, the duty of which is to maintain the lock chambers in their vertical motion; and (d) the lower gateways, which end the lower reach. These walls form a dry pit, or rather two dry pits, into which the metal lock chambers descend.

The breast wall is 40 ft. thick and about 80 ft. high, the length being 126 ft. at the base. At about 15 ft. above the rock foundation there is formed within it, for convenience, a chamber or room which is called the pump room, in which the pressure pumps and turbines are installed. This room is 12 ft. wide, 17 ft. high and 110 ft. long. At about the original natural surface of the ground the breast wall is pierced longitudinally by a roadway, which will form a continuation of the main street running through the city of Peterborough. This roadway is 14 ft. wide and 21 ft. high. In the top of the wall are formed recesses for the gates which close the ends of the upper reach. Stairways are provided to give convenient access to the various parts of the structure.

The towers, three in number, are on the same transverse center line as the wells for the presses. In round numbers the total height of each tower from rock bottom to the top is 100 ft. Each of the side towers has a base of 29 ft. 6 in. x 40 ft. 8 in., decreasing to 24 ft. 6 in. x 30 ft. 6 in. at the top of the side walls. From this point upwards the base has a batter for a height of 45 ft., and above this the shaft is vertical, and is 18 ft. x 18 ft. 6 in. For operating purposes it is necessary to build the inside face of the towers plumb from bottom to top. The center tower has for the same reason to be plumb on the two sides next the lock chambers, while its other two sides

conform to the same lines as those of the side towers. Its width throughout is 12 ft. The towers have been treated in the same architectural manner as the breast wall.

The lower gateways extend from rock bottom to the top of the side walls, and are built to accommodate the steel gates which close the ends of the lower reach. In the center wall between the gates is a small chamber or room which contains the machinery for operating the gates.

As far as possible, all the substructure has been built in sections to make provision for expansion and contraction, and to obtain as nearly as possible evenly distributed pressures on the foundations. An effort was made to have the sections not exceed 40 ft. in length.

The proportions of ingredients of the concrete have been generally one cement to 2½ of sand, with as much gravel and broken stone as could be thoroughly embedded by the mortar. For very important parts the strength of the mortar was increased by using one cement to 2 of sand, while in less important places the mixture was made as weak as 1:4. All exposed faces were made by depositing from two to three inches of mortar against the forming immediately before, or simultaneously with, the concrete course. The courses or layers were always kept horizontal and were generally 10 in. deep. The closest watch was kept on all operations of mixing and placing the concrete and the alinement of forming, and laboratory tests were constantly made on the cement. About 95 per cent. of the cement used in the work was Canadian Portland, and proved very satisfactory.

The forming for important faces of walls was made of 3-in. pine plank, dressed on one side to the proper thickness. All joints were rabbetted or ship-lapped. The studs were made of 6-in. x 8-in. timbers at about 4-ft. centers, backed up by heavy horizontal wallings. The wallings were held in place by ⅝-in. rods embedded in the concrete as the work progressed. On the backs of walls against which earth was filled no particular care was taken, reasonable alinement being kept with a forming of 1-in. rough pine or hemlock boards.

Machine-mixed concrete was used throughout the work. About half was made in a mixer of the continuous type, and the remainder by a cubical mixer. A cableway was used for delivering the concrete from the mixers and depositing it in place in batches of about 1 1/3 yds. at a time.

The superstructure of the lock is under contract with the Dominion Bridge Company, of Montreal. Shop work was commenced in the summer of 1901, and field erection in October, 1902. The whole will be completed this spring.

Each of the lock chambers is 139 ft. x 33 ft., with 9 ft. 10 in. of plating on the sides. These dimensions, with the exception of the depth of water, are fixed by the Government Commission, and it is necessary that a clear headway of 25 ft. be left above the water level. The depth of water for which the lock is constructed would in ordinary navigation language be called 8 ft. on the sills. The load of water which each of the lock chambers will contain is about 1,700 tons, and this is the maximum load which it will be necessary to provide for, since when a vessel is floating in the chamber it is merely a question of displacement. The trusses which carry the load of the chambers are double cantilevers, having curved top and bottom chords. The depth of the trusses at the center is 32 ft., this depth having been chosen with a view to preventing the teetering of the chambers. The trusses are simple and it is unnecessary to provide for alternate stresses in any of the members, the load being constant and always in the same direction. All the connections are riveted. The top chord cover plate is 30 in. wide. The diagonals are universal mill plates. The floor beams and stringers form a very stiff system. The plating of the chambers is ⅜ in. thick on the floor and 5/16 in. on the sides. All the joints of the plating are made with single butt splice plates, planed to bevel on both edges and caulked, and the riveting is similar to boiler work.

The whole load of the chambers is brought directly upon the top of the rams by plate girders 9 ft. deep. There are four of these girders to each chamber, each girder taking practically an equal share of the load.

In order to maintain the chambers in their vertical course, guides are provided at the towers and at the breast wall, the anchorages having been embedded during the construction of the concrete work. Corresponding slides are attached to the chambers. All the guides combine to counteract the rotating tendency due to the unbalanced wind forces, while the teetering tendency is overcome by the central slides which are fastened to the top and bottom chords of the trusses.

The gates and their operating machinery are of a different type from anything that has hitherto been employed for this purpose. There are eight gates in all, one on each end of each chamber, and one on each end of each reach. Each gate is hinged along its lower edge and is provided with galvanized air chambers of sufficient capacity to render it practically buoyant. As it is never necessary to operate any gate singly they have been arranged to work in pairs and to engage automatically. Each of the downstream pairs are operated by a small three-cylinder hydraulic engine placed on the line of the axis of the reach gates in the small room provided for the purpose in the concrete wall between the gateways. A similar engine is employed for the upper gates. Through the chain, motion is imparted to the pinion engaging with the segmental rack anchored to the wall. There is a similar rack on each side of the gateway, the top shaft being carried across the gate. When open, both gates lie flat upon the bottom, leaving the full navigation depth. The gates are steel throughout, the framework consisting of a series of vertical I-beam posts, which connect to the top girder, giving a perfectly determinate system of stresses throughout, and bringing definite abutment loads where they can be readily cared for. The plating is all on the outer sides of the gates (that is, the adjacent faces of any pair), is 5/16 in. thick on the upper parts, ⅜ in. thick below, butt-spliced and caulked in the same way as in the lock-chambers.

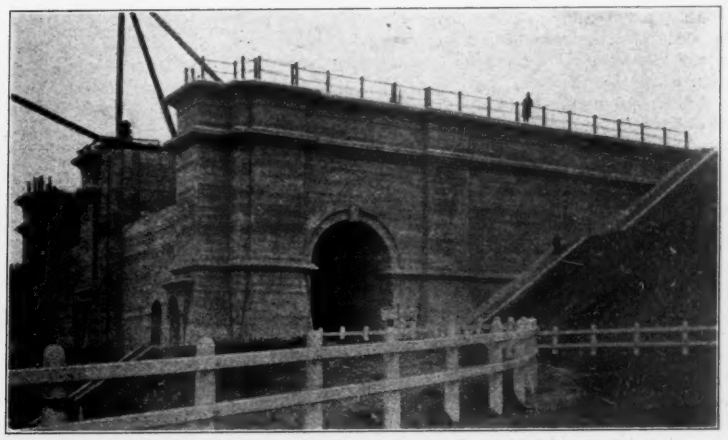
Water tightness is ensured between the gates and chambers, or gates and reaches, by means of a rubber strip or flap, about 3 in. x ½ in., fastened along the sides and bottom of the frame against which the gate closes. The pressure of the water keeps the strip tightly pressed against the gate, in this way preventing leakage. The edge against which the rubber bears is machined to a true surface.

There is a space of nearly 2 in. between either end of a lock chamber and the frame of the reach gate. When it is desired to connect a lock chamber with a reach this clearance space has to be closed. This is done by having a collapsible rubber tube fastened to the frame of the reach gate and arranged so as to lie flat. When the lock chamber is in position for communication the rubber tube is inflated with air at about 10 lbs. per sq. in. pressure, which causes it to expand and press against the end of the chamber.

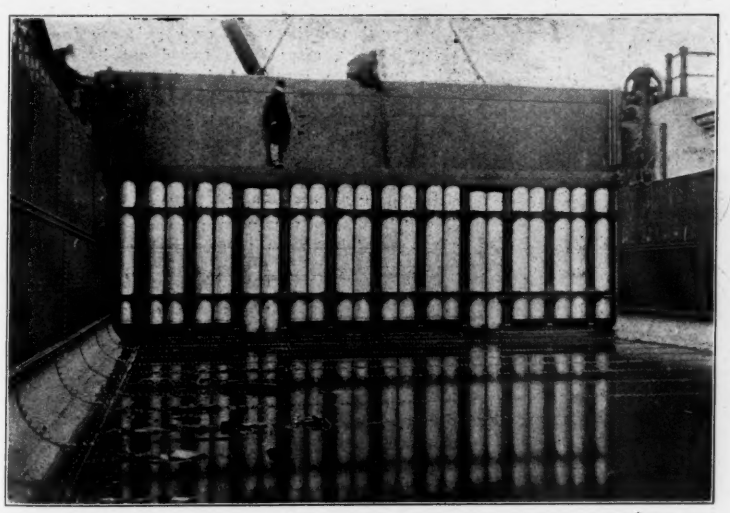
The main presses form the most interesting as well as the most important part of the whole structure. It is thought that they are the largest hydraulic presses that have ever been made. Each ram is 90 in. external diameter and has a working stroke of 65 ft. The gauge pressure in the presses during operation is nearly 600 lbs. per sq. in. The inside diameter of the press is 7 ft. 8½ in., giving a water space of 1¼ in. all round between the ram and press. The rams are built of cast iron, 3¼ in. thick, made up in sections. Each section is 5 ft. 3 in. long and is bolted to the adjacent ones by bolts through inside flanges, for which purpose forty 1¼-in. bolts are used. The joints between the sections are made with a gasket of thin copper, rolled true to gage, 1/16 in. thick by ¾ in. wide. This gasket is brazed in the form of a ring. The ends of the ram sections are rabbetted to fit into one another and have male and female corrugations. The copper is put in flat and when the joint is screwed down tightly becomes corrugated, making the joint perfectly tight.

The presses are made of steel castings, built up similarly to the rams. The internal diameter is 7 ft. 8½ in. The thickness of the metal is 3½ in. and the length of the

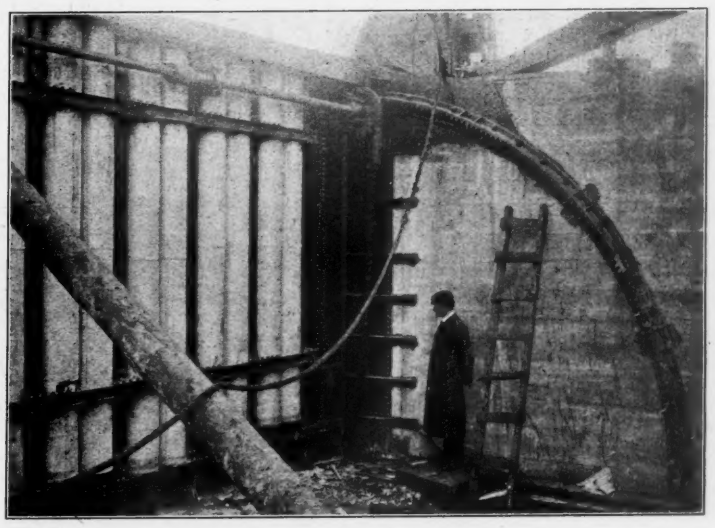
Peterborough Hydraulic Lock During Erection of Superstructure.



Concrete Breast Wall—Peterborough Hydraulic Lock.



Upper Chamber Gate With Air Chambers in Position.



Gate Operating Mechanism.

sections 5 ft. 3 in. The sections are flanged at both ends. The flanges are faced and rabbetted male and female. The faces of the rabbets are also corrugated male and female to receive a soft copper gasket similar to that used in the rams. In addition to the copper a lead gasket was also used in the press joints, being placed in a V-shaped groove cut in the flanges about three inches outside the circle of the copper gasket. The lead was put in round, ½ in. diameter, and distorted to nearly fill the groove in the process of making the joint. Fifty-six bolts 1⅝ in. in diameter were used in each of the press joints.

The top of each press is finished with a stuffing box of rectangular form, 1 in. wide and about 10 in. deep. This box contains 12 rings of braided hemp packing, which before using is about 1 in. square. The hemp is tightened down by a steel gland or follower with 36 stud bolts tapped into the top section. Each press is stayed to the walls of the well near the top by adjustable struts, enabling the press to be accurately centered before the erection of the lock-chambers began.

The pipe connecting the presses near the top and just below the stuffing-boxes is 12 in. in diameter. Through this pipe all the water displaced by a descending ram is driven into the other press causing its ram to rise. Midway between the presses and immediately under the center of the middle tower a gate valve is placed in the 12-in. pipe, to make connection from one press to the other, or shut it off as occasion may require. This valve is controlled solely by the lockmaster in his cabin on the top of the middle tower. Beside the main gate valve there are two auxiliary valves operated automatically by the lock during its motion. These valves serve as a protection against possible accident to the gate valve, and each is closed by the chamber on reaching the end of its stroke, the closing being started about the last eighth or 8 ft. of stroke.

After manufacture and before erection all the castings of the presses and rams were subjected to rigid hydraulic tests to a gage pressure of 1,200 lbs. per sq. in., being twice the working pressure. Under this load the steel did not show the least trace of oozing, and the micrometer measurements proved the extensions to be remarkably uniform. Tests were also made on full size joints and they also were perfectly tight.

The erection of the presses was conducted during the winter season. The pieces, which averaged about 10 tons each, were all handled and lowered with a stiff-leg derrick. A very ingenious method was adopted for the erection of the rams. After each press had been completed the opening for the 12-in. crossover pipe was closed with a temporary cover and the press was filled with water to the top. Then the base of the ram was entered into the press, the weight being still held by the derrick. As soon as the packing was placed ond the gland screwed down the hooks were taken off the ram base which was then supported on the confined water within the press. The next ram section was brought and placed and after the joint with the base had been finished water was permitted to escape from the press until the ram settled down through the stuffing-box the length of the section. In this manner the ram sections were successfully placed and immersed one at a time until the cap was in position.

It is interesting to note the principles employed in constructing the presses of other hydraulic locks. The largest rams are 2 meters in diameter. In one the presses are made of cast-iron sections strengthened by steel hoops shrunk on the outside. In the other the presses are made of steel hoops piled one upon another and rabbetted together, water tightness being secured by a copper lining or bag.

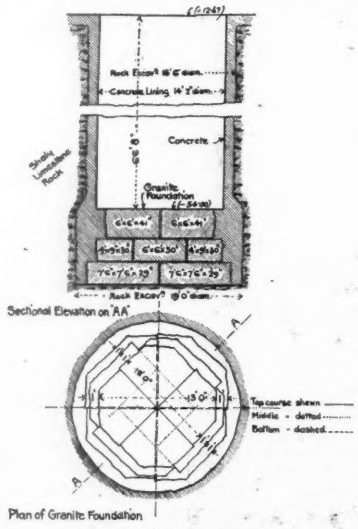
The auxiliary plant in connection with the Peterborough lock consists of a hydraulic accumulator with its accessories, two hydraulic gate engines, two hydraulic capstans, an air compressor, an air waterlift, a deep well pump and a lighting dynamo.

The duty of the accumulator is to supply water under pressure to the main presses for the purpose of making good any slight leakage of the large glands or the adjustment of the relative height of either chamber. It also supplies power to the gate engines and the capstans. The ram of the accumulator is 20 in. in diameter and the working stroke 30 ft. 6 in. The working pressure is intended to be 625 lbs. per sq. in. The accumulator is installed in the east side tower and gets its water supply from one of a duplicate pair of pressure pumps in the pump room in the breast wall. These pumps are operated by a 16-in. horizontal turbine driven under a 65-ft. head by water from the upper reach of the canal. The accumulator differs from the regular type by having its ballast box directly above the ram instead of the usual annular form, the advantage so gained being an efficient bracing of the accumulator press to the walls of the tower.

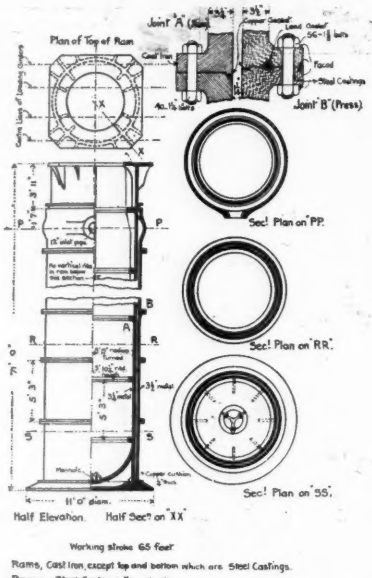
The pressure pumps are of the three-throw type, single acting, having bronze plungers, and are geared down from the turbine. Two pumps are provided, either of which may be used under ordinary circumstances, or if necessary both may be connected. The accumulator automatically regulates its motive power. One three-cylinder hydraulic engine operates the lower gates, and a similar one operates the upper gates. One hydraulic capstan is on the lower level and the other on the upper. The gate engines and capstans are all actuated by the accumulator.

The air compressor, built under the patents of the Taylor Hydraulic Air Compressing Company, is in a void in the breast wall. It gets its supply of water from the upper reach. The air to be compressed becomes entangled with the water passing through a peculiarly constructed headpiece at the point of inlet, and is then dragged down by the water to a depth considerably below the elevation at which the water escapes, being collected at the lowest level and thence delivered for use. The bottom of the headpiece is about 10 ft. below the surface of the water and is connected by an 18-in. downpipe with a collecting tank 85 ft. below it. The downpipe descends in a 42-in. shaft and the tank, 11 ft. in diameter, is in a chamber 14 ft. in diameter. As the collecting tank is bottomless and on legs raising it 6 in. clear of the floor, the water, after leaving the air bubbles collected in the top of the tank, rises in the 42-in. shaft and escapes through an outlet about 17 ft. below the inlet level. The imprisoned air in the collecting tank is under the pressure due to the column of water from the water line within the tank to the point of escape, which in this case is about 28 lbs per sq. in. From the collecting tank the air is conveyed by pipes to the pump room and from there to the seal tubes to be used for inflation.

A summary of the amounts and various kinds of metal used in the superstructure is as follows: Rolled steel in plates and shapes for the lock chambers and gates, 1,680,000 lbs.; cast iron in rams, accumulator, guides and various machines, 495,000 lbs.; steel castings for the main presses and accumulator, 668,000 lbs.



Details of Press Well.


Plan of Top of Ram
Joint 'A' (Ram)
Joint 'B' (Press)
Sec! Plan on 'PP'
Sec! Plan on 'RR'
Sec! Plan on 'SS'
Half Elevation
Half Sect on 'XX'
Working stroke 65 feet
Rams, Cast Iron, except top and bottom which are Steel Castings.
Presses, Steel Castings throughout

Details of Main Presses.

The operation of the lock requires three men—a lockmaster and two assistants or gatemen. The lockmaster will be in charge. The gatemen will be required, one at the lower end and the other at the upper, to open and close the gates, to inflate or deflate the seal tubes between the ends of the chambers and the reaches, and to operate the capstans. It is also necessary for the gatemen to take charge of vessels at a distance of about 200 ft. on either side of the lock. The lockmaster, during operations, will be required to stay in his cabin, on the top of the central tower, where he will have full view of all that transpires, and also be in communication with both his assistants by a simple signal system. The lockmaster will have the principal levers before him and through an interlocking system will regulate all the workings of the lock. The levers for controlling the gate engines and capstans are situated on the wall immediately above the respective machines, convenient of access to the gatemen. The interlocking system is so arranged that the lockmaster must set his levers in the proper order, and these having been set neither he nor the gatemen can err by using their levers at the wrong time.

In order to get a clear idea of the complete mode of operation let us assume that both lock chambers are down at the lower level, and empty, as they will be at the end of the winter or when it is desired to prepare them for navigation purposes. The annular space in each of the presses will be filled with water by the pumps. The main valve on the connecting pipe will be closed and water will be pumped into one of the presses until the ram with its superimposed chamber rises to the level of the upper reach. An examination of the case will show that it is necessary that the uppermost chamber, in order that it shall be able in descending to cause the other to take the full upward stroke, must contain a volume of water greater than the rising chamber contains. This extra amount of water is equal to the volume of one of the rams, since the change that takes place during the relative motion of the two chambers is that the ram of the descending chamber becomes constantly immersed while the other protrudes. In other words, the descending chamber is losing weight while the ascending one is constantly becoming heavier. It is also necessary that some extra weight be provided to overcome the friction of the guides and of the stuffing-boxes of the main presses. The area of each lock-chamber is so great that it requires only an additional depth of 8¼ in. to give an extra load of water of 100 tons, which will, it is expected, prove sufficient. The addition to this weight will, of course, have the effect of accelerating the time of the relative change in position of the chambers. It is intended that the actual time required in raising the chamber through the whole elevation will be about three minutes. But this will depend upon the adjustment of the main glands, the nicety of the working of the guides and the manipulation of the main valve in the hands of the lockmaster. In the European locks this part of the lockage is readily performed in three or four minutes.

An ordinary lockage will be conducted in this manner: Suppose 100 tons of "surcharge" has been found to give sufficient additional weight to the descending chamber. The uppermost chamber will then be required to stop with its floor 8¼ in. lower than the bottom of the upper reach. On communication being established between it and the reach it will receive from the reach 100 tons more than the lower chamber contains, assuming the depth in both reaches to be the same. Then the total operations to form the lockage, assuming that the gates adjoining the reaches are open and that the seal tubes between the chambers and reaches are inflated, will consist in hauling the vessel into the chamber and mooring her there securely, closing the gates, deflating the seal tubes and opening the main valve between the presses. The heavier chamber will commence to descend, the motion being allowed to increase gradually by the gradual opening of the valve, until it reaches the maximum speed. At about three-quarters of the stroke the main valve is slowly closed, communication between the presses being entirely cut off when the end of the journey is reached. The change in elevation being made the seal tubes are inflated, the gates are opened and the vessel or vessels are free to go on their journey, after being towed out by the capstans. The surcharge contained in the descending chamber simply flows out into the lower reach, while a similar quantity to perform the next lockage is admitted into the chamber which has just reached the higher elevation.

The advantages claimed for the hydraulic lock over those of the ordinary type are saving of time, economy of water and increased capacity. With reference to capacity it will be noticed that vessels traveling in opposite directions may be locked through simultaneously.

Reaming Structural Steel.*

The benefit expected to be obtained by reaming structural work is twofold, viz., to remove the metal injured by the punch and to improve the fit of punched holes. A difference of opinion seems to exist as to the nature of the injury caused by the punch; whether it is due to minute cracks or to compression of the metal. The effects of annealing punched specimens as presented seem to show that cracks are not present to a damaging extent, though many have held the contrary view. There is no doubt but the harder grades of steel crack under the punch at times, but the cracks usually extend to the edge of the piece, and the only remedy is to throw the piece on the scrap pile and get a new one. This is especially the case with Bessemer steel between 60,000 and 70,000 lbs. ultimate strength. On the softer grades it appears that the punch has the same effect as cold working of any kind. It forces the molecules of the steel closer together on the die side of the punched piece. This will raise the elastic limit as well as the ultimate strength of the parts affected, while it will not necessarily change the modulus of elasticity. If this is the case (that the modulus of elasticity is unchanged), then the affected parts around the hole take only their proper part of the strains, if these strains are within the elastic limit of the soft steel away from the hole. If these strains go above the elastic limit of the soft steel, this will commence to yield, throwing a proportionately larger strain on the harder steel around the hole. The elastic limit will then soon be reached for the harder steel. If the strains are gradually increased, the softer steel as well as the harder will elongate, but as the softer steel will elongate more than the harder, the strains will be higher in the harder steel than in the softer and will finally reach the breaking

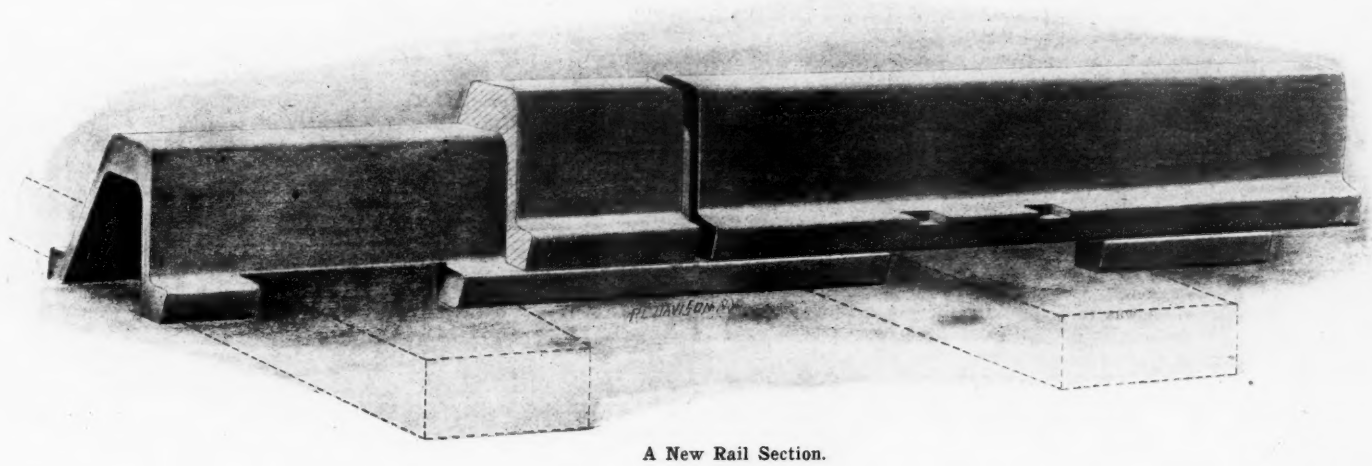
*From a report to the American Railway Engineering and Maintenance of Way Association, March, 1904.

point before this point has been reached in the softer steel.

As all tests have been tests to destruction, it is plain that the material should start giving way at the rivet holes, if the above reasoning is correct. In our structures the strains should be well below the elastic limit, and there is no reason to believe that cutting away the hardened ring around the punched hole will in any way strengthen the piece as long as it is subject to these strains only. The hot rivets have a tendency to anneal the steel around the holes, and it would be interesting to know how far its effect extends. The damage appears to be wholly on the die side of the piece punched, and as this is the location of the most severe compression, it seems reasonable to suppose that the damage inflicted by the punch consists largely of the compressive action of the die. The removal of a very slight amount of material appears to be sufficient, but it must be done before the parts are assembled, as experience shows that very many holes will have only one side reamed if done after assembling. For improving fits, reaming must be done after assembling, and if both of the benefits stated above are desired, double reaming as specified by a very few engineers must be resorted to.

A New Rail Section.

The accompanying illustration shows a new rail section, the invention of Dr. Vietor and Mr. Husham, of Wiesbaden, who are represented in this country by M. Barschall, Bank of Commerce Building, New York City. The claims made for the rail are that it has about six times the lateral and 50 per cent. more vertical strength than the present T-rail of equal weight. It is designed so that the upper outer lines of the section correspond with the inner lines. The same pair of rolls can be used for different weights of rails by simply spreading them apart. This also, owing to the design, increases the thickness proportionately throughout the rail and the small opening required between the rolls produces a very hard rail. The rails can be piled one in another, thus saving space, which is, no doubt, some advantage such as when shipping. This characteristic is also made use of in the joints as shown, a portion of the rail itself being used. A large bearing as well as an elastic joint is produced by using wooden blocks fitted into the rail over the ties. No bolts are used in the joint. If this rail should do well a great saving in first cost, owing to reduced weight per mile, as well as a saving in maintenance on account of the simplicity of the joint, can be made.



A New Rail Section.

Train Accidents in the United States in February.[1]

rc, 1st, Philadelphia, Baltimore & Washington, Farnhurst, Del., a passenger train ran into the rear of a preceding freight; the engineman of the passenger train was killed and the fireman and six passengers were injured.

bc, 1st, at Union Station, Chicago, Ill., butting collision between a northbound passenger train of the Chicago & Alton and a southbound passenger train of the Chicago, Burlington & Quincy. A switch tender was killed and four passengers were injured. The weather was extremely cold and a cloud of steam interfered with the view of the incoming engineman. It is said that this difficulty of seeing ahead was the immediate cause of the collision.

unf, 1st, Colorado & Southern, Georgetown, Col., three cars of a passenger train were overturned by a high wind and five passengers were injured.

rc, 2d, Chesapeake & Ohio, Buena Vista, Va., collision between a passenger train and a switching freight train, wrecking one engine and one baggage car. The engineman of the switching train was killed.

rc, 2d, Grand Rapids & Indiana, Wayland, Mich., passenger train No. 9 ran into the rear of preceding passenger train No. 11 and nine passengers and one trainman were injured.

*xc, 2d, Alabama Great Southern, Birmingham, Ala., passenger train No. 3 ran over a misplaced switch and into some freight cars on a side track. The engineman was injured. Four freight cars were wrecked and took fire, but the fire was soon extinguished.

xc, 2d, Chicago Terminal Transfer Railroad, Chicago, Ill., a switching engine which had been left unattended was started in some unaccountable manner and after running some distance at high speed collided with a passenger train at Ashland avenue and West 15th street. Two men were killed.

eq, 2d, St. Louis & San Francisco, Quincy, Mass., passenger train No. 206 was derailed by the breaking of a wheel of the tender and the first two cars were overturned. Three trainmen and six passengers were injured.

unx and unf, 2d, Southern Pacific, Findlay, Texas, an empty engine was derailed and overturned and the engineman and fireman were killed. No person surviving to give a warning signal—

A freight train of the Texas & Pacific, which, after a considerable time, followed the empty engine, ran into it and was derailed; and one brakeman was killed and the fireman injured.

unx, 3d, Central of Georgia, Covington, Ga., a freight train was derailed and a brakeman was killed.

rc, 4th, 11 p. m., New York Central & Hudson River, Lockport Junction, N. Y., a passenger train which was stuck in a snow bank was run into at the rear by a following passenger train, and 12 passengers were injured.

dr, 5th, Pennsylvania Railroad, Corry, Pa., a passenger train was derailed by a broken rail and all of the cars were ditched.

unx, 5th, New York Central & Hudson River, Watertown, N. Y., a passenger train consisting of an engine and two cars was derailed and fell down a bank. The engineman, fireman and one passenger were injured.

unx, 6th, Lehigh Valley, Tonawanda Junction, N. Y., passenger train No. 691 was derailed and the engineman and fireman were injured.

bc, 8th, Illinois Central, Mayfield, Ky., butting collision of freight trains, badly damaging both engines and several cars. Two trainmen were injured, one of them fatally.

bc, 8th, 8 p. m., York, Ala., butting collision between passenger train No. 15 of the Southern Railway and a freight train of the Alabama Great Southern. The engineman and fireman of the passenger train were killed and three other trainmen and several passengers were injured.

unf, 8th, 8 p. m., St. Louis, Iron Mountain & Southern, Reedville, Ark., a freight train was derailed by running over a cow, and the engine, 9 cars of the train and 4 empty freight cars on a side track were wrecked. The engineman and fireman were killed.

dr, 9th, Union Pacific, Wyuta, Wyo., eastbound passenger train No. 2 was derailed by a broken rail and one passenger car was overturned. Many passengers were injured, but, according to the reports, none seriously.

†rc, 12th, Great Northern, Pennock, Minn., westbound passenger train No. 3 ran into a freight train, wrecking the caboose and damaging the engine and several cars. Three passengers in the caboose were killed and 10 passengers and two employees were injured.

eq, 12th, Wheeling & Lake Erie, Zoar, Ohio, a freight train was derailed by a broken wheel and a part of it broke through a bridge over the Tuscarawas River. Ten loaded cars in the middle of the train fell into the stream below.

bc, 13th, Atlantic Coast Line, Pee Dee, S. C., butting collision of freight trains, wrecking both engines and several cars. One engineman was killed and six other trainmen were injured.

bc, 13th, Galveston, Harrisburg & San Antonio, Flatonia, Texas, butting collision between a freight train and a gasoline motor car, badly damaging the engine and wrecking the motor.

bc, 13th, Louisville & Nashville, Howell, Ky., butting collision between two locomotives; one fireman was killed and five other trainmen were injured. It is said that the engineman of one of the engines, a switching engine, forgot a meeting order.

unx, 14th, Kansas City Southern, Sheffield, Mo., one of the two locomotives of a freight train was derailed at a switch and overturned, and the engineman was killed.

dr, 15th, Pennsylvania Railroad, Marwood, Pa., a passenger train was derailed by a broken rail and two passenger cars were overturned. Twenty passengers were injured.

rc, 16th, Pennsylvania Lines, Crestline, Ohio, a passenger train ran into the rear of a preceding freight, wrecking the engine and five cars. Three trainmen were injured.

bc, 16th, 10 p. m., Nashville, Chattanooga & St. Louis, Cowan, Tenn., a northbound freight train, consisting of five engines and a large number of cars (three trains coupled together) collided with a standing train at the foot of a steep grade. Five trainmen were injured. It is said that the collision was due to a misplaced switch or to a misunderstanding as to which one of the several side tracks the long train should enter.

dr, 16th, Western & Atlantic, Bolton, Ga., a passenger train was derailed by a broken rail and the first four cars were overturned. The derailment was due to the breaking of one of the axles of the tender. Several passengers were injured.

*16th, 1 a. m., International & Great Northern, Healy, Texas, northbound passenger train No. 4 was derailed at a switch which was defective or had been left part way open. The engine, an oil burner, was overturned and took fire, and oil leaking from the tank set fire to the mail, baggage and express cars and one passenger car, which were quickly consumed.

bc, 17th, Pennsylvania road, Washington Crossing, N. J., butting collision of freight trains; one engineman and one fireman killed and 5 other trainmen injured. The collision was due to disregard of a meeting order by the engineman of one of the trains (who was killed).

xc, 17th, Pittsburg, Cincinnati, Chicago & St. Louis, Bicknell, Ind., a freight train collided with some coal cars which had accidentally run from a side track on to the main line. A brakeman was killed and two other trainmen were injured.

dn, 17th, Baltimore & Ohio, Piedmont, W. Va., a freight train became uncontrollable on a steep grade and was derailed at a curve, 18 loaded cars falling down a bank. The fireman was killed and one other trainman was injured.

rc, 18th, Atchison, Topeka & Santa Fe., Kansas City, Mo., a westbound passenger train, which had slackened speed on the approach to a junction, was run into at the rear by a following passenger train; four persons were injured.

xc, 18th, 1 a. m., Pennsylvania road, Granville, Pa., collision between a freight train and a light engine; one employee killed.

19th, Erie road, Elmira, N. Y., an eastbound freight train standing near the station was run into at the rear by a following freight, badly damaging the engine and seven cars. The fireman was killed and the engineman injured. It is said that the collision was due to a false clear signal given at the last preceding block station. There was a blinding snowstorm at the time.

rc, 20th, Southern Pacific, Jackson, Utah, a freight train which had become uncontrollable on a descending grade in consequence, it is said, of some difficulty with the air-brakes, ran into the rear of a preceding freight train standing at the station. In the standing train were two cars of dynamite; these exploded and destroyed 12 freight cars and five locomotives, the station building and all structures for a considerable distance around. Twenty-four persons were killed and 13 were injured, a large number of the killed being laborers who were in a car on the side track.

bc, 20th, Pennsylvania Lines, Hobart, Ind., butting collision between eastbound passenger train No. 6 and a westbound freight train, wrecking both engines and several cars. The baggageman was killed and five other persons were injured.

bc, 21st, Illinois Central, Paducah, Ky., butting collision between a passenger train and a train consisting of two empty engines; one fireman was killed and one engineman injured. There was a dense fog at the time.

bc, 21st, Southern Railway, McCarty, Tenn., butting collision between freight train No. 185 and an empty engine, wrecking both engines and 10 cars. Six trainmen were injured, two of them fatally. The empty engine had left its train to run to a tank and was on its return. It is said that the collision was due to the neglect or inefficiency of a flagman who had been sent to stop the empty engine.

†dr, 22d, Cleveland, Cincinnati, Chicago & St. Louis, Wauponsee, Ill., a passenger train was derailed in consequence, it is said, of a defective frog; one passenger car was overturned. One passenger was killed and five were injured.

dr, 22d, Texas & Pacific, Olla, La., a passenger train was derailed by a broken rail and three passenger cars were overturned. Seven persons were injured.

bc, 22d, Southern Railway, Pheba, Miss., butting collision of freight trains, wrecking both engines and several cars. One fireman was killed and two other trainmen were injured.

*o, 22d, Southern Pacific, Tehachapi, Cal., the (oil-burning) locomotive of a passenger train of the Atchison, Topeka & Santa Fe was set afire by oil which escaped between the engine and the tender, and the engine, tender, composite car next behind the tender and the station building were destroyed. The fire seems to have started while the train was standing at the station. A high wind was blowing.

o, 22d, 10 p. m., Pennsylvania road, Ehrenfeld, Pa., the locomotive of a freight train was wrecked by the explosion of its boiler; three employees were killed and two fatally injured.

unx, 23d, Southern Railway, Maryville, Tenn., a mixed train was derailed and one car was overturned. The conductor was killed and several persons were injured.

o, 23d, Pennsylvania road, Ludlow, Pa., the locomotive of a freight train was wrecked by the explosion of its boiler; one man was killed and two were injured.

unx, 24th, Colorado & Southern, Loveland, Col., a

[1] Accidents in which injuries are few or slight and the money loss is apparently small, will as a rule be omitted from this list. The official accident record published by the Interstate Commerce Commission quarterly is regularly reprinted in the *Railroad Gazette*. The classification of the accidents in the present list is indicated by the use of the following

ABBREVIATIONS.

rc	Rear collisions.
bc	Butting collisions.
xc	Miscellaneous collisions.
dr	Derailments: defect of roadway.
eq	Derailments: defect of equipment.
dn	Derailments: negligence in operating.
unf	Derailments: unforeseen obstruction.
unx	Derailments: unexplained.
o	Miscellaneous accidents.

An asterisk at the beginning of a paragraph indicates a wreck wholly or partly destroyed by fire; a dagger indicates an accident causing the death of one or more passengers.

passenger train was derailed and nearly all of the cars were overturned and ditched. A number of passengers were injured.

†rc, 25th, 8 p. m., Chicago Great Western, Dyersville, Iowa, an eastbound freight train which was switching at the station was run into at the rear by a following freight, damaging the engine of the second train, a pushing engine at the rear of the first train, and the caboose and several cars. A drover and one other man in the caboose and the fireman of the second train were killed and a drover and two trainmen were injured.

rc, 26th, 3 a. m., Southern Railway, Durham, N. C., a freight train which had been unexpectedly stopped was run into at the rear by a following freight, and the engine and five cars were wrecked. Two trainmen were injured.

xc, 25th, Pennsylvania road, Rockville, Pa., a passenger train collided with some freight cars being switched on the main track, and the engineman was killed.

unf, 26th, 2 a. m., Seaboard Air Line, Panasoffkee, Fla., passenger train No. 50 broke through a trestle bridge which had been weakened by fire, and one passenger car was overturned. Several passengers were injured.

xc, 27th, Seaboard Air Line, Athens, Ga., collision of freight trains; one engineman killed.

*unx, 27th, Norfolk & Western, Henry, Va., a freight train was derailed and the two engines drawing it, together with nine cars, were wrecked. The wreck took fire and was partly burnt up. Two enginemen and one fireman were killed and one other trainman was injured.

unx, 27th, Grand Trunk, Helena, N. Y., a passenger train was derailed and 11 passengers were injured.

bc, 28th, Alabama Great Southern, Coaling, Ala., butting collision of freight trains, wrecking both engines and several cars. One of the trains had stopped at the station and the other one approached at uncontrollable speed. A tramp was killed and one engineman was injured.

unf, 29th, Atlantic Coast Line, Alapaha, Ga., a passenger train was derailed at a misplaced switch and three trainmen were injured. It is said that the switch had been maliciously misplaced.

Water Softening.

At a recent meeting of the Engineers' Society of Western Pennsylvania, Mr. James O. Handy, Chief Chemist of the Pittsburg Testing Laboratory, read a paper on the above subject. The first part of the paper gives a good history of the development of water-softening apparatus, including general descriptions of the prominent types of apparatus now on the market. Mr. Handy concludes that the essential principles of water softening on which any successful machines must be based are:

In a continuous system the feeding of chemicals must be very precise and capable of easy adjustment and the devices must be simple.

The chemicals and water must be thoroughly mixed for a sufficient length of time under proper conditions so that the softening process is completed before using the water.

The internal construction of a continuous machine should be such that the steady progress of the water through the machine is certain. There must be no eddies and if the supply is delivered intermittently or the rate of pumping is variable, it is essential that the uneven flow be counteracted.

In order to reduce the trouble and expense of operation the apparatus should be designed so that clarification is very complete, thus leaving little work for the filters.

A continuous apparatus should hold four times the maximum hourly output. In an intermittent type of apparatus the time for filling and emptying tanks must be added to the four hours standing. This makes the tank area in the intermittent system usually about twice that in the continuous system.

The softened water should be entirely clarified when discharged.

Labor and superintendence must be cut down to the minimum and high class labor should be employed.

The continuous system has the advantages of simplicity and compactness and is cheaper to operate, because it requires less power and less labor and there are fewer valves to get out of order. The maintenance charges are also less if steel construction is used.

Mr. Handy also calls attention to the lack of uniformity in the methods of obtaining and expressing the analytical results on which water softening calculations are based. The method used by the Pittsburg Testing Laboratory is as follows: Evaporation to dryness on the water bath. Treatment with the boiling distilled water free from carbon dioxide. Filtration and washing with boiling water. The residue is thoroughly rubbed up with a rubber-coated rod. If the water is high in sulphates, use plenty of hot water. Dissolve the insoluble part in dilute hydrochloric acid. Determine iron, lime and magnesia volumetrically in both soluble and insoluble portions. Express results as soluble and insoluble lime and magnesia. Determine silica in separate portion. Determine chlorine and sulphuric anhydride by usual methods. Determine alkalinity or acidity by adding a measured excess of standard d.n. sulphuric acid to 100 c.c. of water, boiling 20 minutes in platinum or porcelain, and titrating back with deci-normal sodium hydrate, using phenolphtalein indicator. Calculate acidity to sulphuric acid or alkalinity to calcium carbonate. Determine nitric anhydride by the phenol-sulphuric method, using silver sulphate to remove chlorine before evaporation, and adding a little sodium carbonate to prevent loss in evaporation.

Free carbon dioxide is determined if the sample has been sent in a sealed condition, so that the gas has not escaped. This is determined by titrating 50 c.c. in a nessler tube, with 1/50 N. sodium carbonate.

The calculation of chemical treatment required for softening hard water or neutralization of acid water is based entirely on the amounts of free carbon dioxide, soluble and insoluble lime and magnesia, free acid and iron. It is in the less important matter of arbitrarily disposing the acids among the bases that chemists differ. Proper practice is to calculate insoluble lime and magnesia to carbonates. The residual alkalinity is figured to sodium carbonate. When, however, we have to decide how much of the soluble lime is combined with sulphuric anhydride or other acids, and the same for the soluble magnesia, we realize that we can no longer proceed logically, but must follow an arbitrary practice. It is possible by using dilute alcohol for extraction of the original solid residue to leave calcium sulphate behind with the carbonates of lime and magnesia. This, however, seems of questionable advantage, as the separation of all sulphate of soda is difficult, and sulphuric acid has to be determined twice. This method is not used, but if used it would be best to make the separation by water first, then evaporate to dryness and extract with alcohol. An arbitrary method of calculating is to give the soluble lime first sulphuric anhydride, then chlorine, then nitric anhydride until satisfied. Satisfy soluble magnesia in the same way with what remains, calculate residual acid radicals to soda, unless both soda and potash has been determined. In that case satisfy soda first. The question is whether to recommend the introduction of the alcohol method into ordinary practice for the sake of actually determining sulphate of lime, or to figure all soluble lime to sulphate, if there is enough sulphuric acid present.

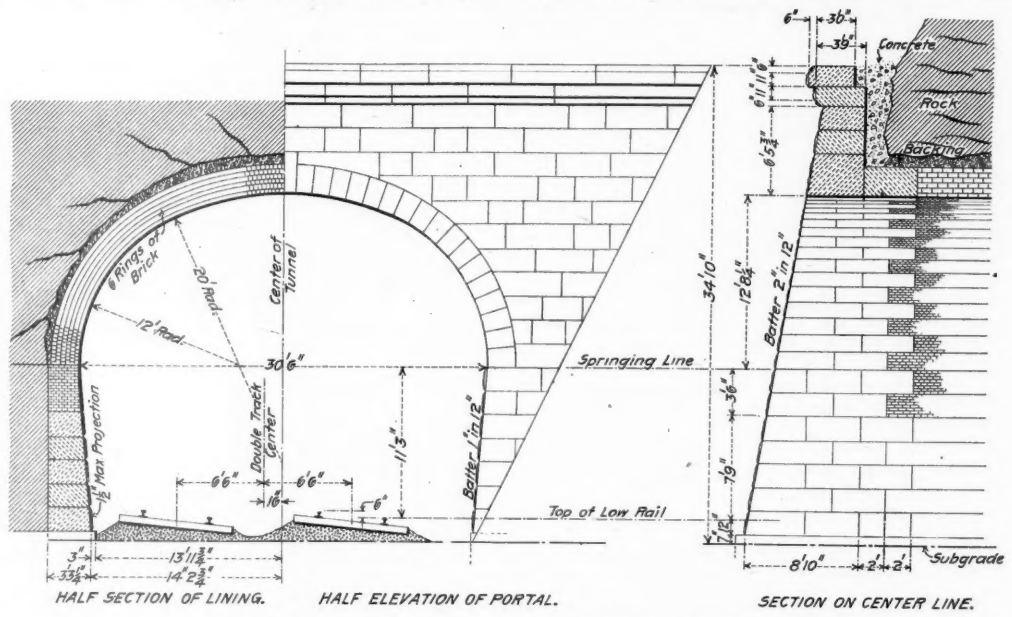
It may be supposed that calcium chloride and nitrate, and the corresponding salts of magnesia, including also the sulphate, do not form scale, and, therefore, need not be removed. In reply to this it may be said that it is doubtful whether any magnesium salts are stable under boiler conditions, and they should all be removed to prevent corrosion. It is difficult, if not impossible, to partially treat a water so as to leave calcium chloride and nitrate undisturbed. They are objectionable, as they change to sulphate if magnesium sulphate is present. They should, therefore, be removed.

Standard Tunnel Section, Norfolk & Western.

A description of some of the most interesting features of the Norfolk and Western was published in the *Railroad Gazette* July 3 and 24 and Sept. 25, 1903. Supplementing these articles, what may be considered as a standard tunnel section on that road is now presented. The drawing shows the portal and section of tunnel No. 3 on the double track line between Elliston and Christiansburg. Modifications are, of course, made to suit the local conditions where such work is done; but, in the main, an attempt is made to adhere to the general standard form shown. As much of the rockwork along the line is soft shale and sandstone associated with the coal formations, lining is a necessary element of the tunnel construction. The lining is formed by an arch, six bricks deep with a concrete grouting between it and the overlying rock, so that the latter is evenly supported and the danger of caving in prevented. These rocks need such a support, else pieces of greater or smaller size are apt to fall down and impose a local overload on the brickwork.

The springing line of the arch is 11 ft. 3 in. above the top of the rail and the latter is 1 ft. 7 in. above the subgrade. The width of the arch at the springing line is 30 ft. 6 in. and it is turned on radii of 12 ft. and 20 ft. for the sides and crown respectively. The sides are of stone with a brick cap, and rise with a batter of 1 in 12. The portals are of cut stone with the front face carried up to a sufficient height to serve as a retaining wall and prevent the sliding of earth or rock down upon the track. In the case illustrated it is 34 ft. 10 in. above the subgrade line. This stonework is laid in cement with 3-16 in. joints, and a face batter of 2 in 12. The track is laid on broken stone ballast, well tamped beneath the ties.

This section is now being substituted in a number of tunnels where the roof was either left unsupported or where timbering was put in in order to save on first cost, and the work will probably be extended to other tunnels on the line until they all conform to the standard. Improvements of this character have brought the road up to its present state of efficiency.



Standard Tunnel Section on the Norfolk & Western.

Performance of Automatic Block Signals Under Unfavorable Conditions.

BY H. S. BALLIET,
Assistant Signal Engineer, Lehigh Valley.

I.—FROST.

[The interest shown by readers in Mr. Balliet's article of Feb. 26 has been so general that we have asked him to discuss automatic signals and the problems of their maintenance and operation more at length, and the first of a series of articles is given below.—Editor.]

Interruptions to the regular operation of automatic block signals occur mostly during the winter months, and principally on account of sudden changes in temperature. Failures peculiar to the summer months are those due to heavy thunderstorms.

The winter of 1903-04 has proved to be the most severe in many years, and signal apparatus has been affected by weather throughout a large territory. A few railroads have for several winters suffered the inconveniences of these weather conditions, but it remained for the present season to determine what kinds and how many signals and how large a territory are susceptible. But few railroads were prepared to anticipate the extreme conditions.

Tests made during the past eight years have developed many peculiarities or "freaks" in the causes of failures of signal apparatus, the most interesting of these being those due to frost. Frost and ice are responsible for many failures noted in daily practice as "cause unknown." The mechanism and controlling parts of signals in boxes and other enclosures are subject to conditions comparable with those attending the formation of dew and afterwards frost on grass, fences and board walks. Frost forms within some enclosures more readily than in others. Dew is formed at night, frost occurs in the morning.

The air always contains moisture. The amount it can hold depends upon the temperature; warm air more, cold air less. A cubic yard of air, at 75 deg. F. will hold half an ounce of water. A reduction of 27 deg. will cause half that quantity to be deposited. When the air is saturated with moisture, or, more properly, vapor, any fall of temperature will condense a part of the vapor. Grass, at night, becoming cooled by radiation, condenses upon its surface, the vapor of the air. Dew will gather most freely upon the best radiators, as they will the soonest become cool. It will not form on windy nights even if the wind is light, because the air is constantly changing and does not become cool enough to deposit its moisture. When the temperature of the grass falls below 32 deg. F., the vapor or moisture is frozen into hoar-frost.

The precipitation of moisture within enclosures is diametrically opposite to that just described, except that the condition is noted in the morning when the sun is above the horizon (the sky need not be cloudless). The heat of the sun strikes the earth, and this heat is radiated back as obscure heat in long slow waves. The heat from the sun is transmitted to the earth in straight lines and does not heat the surrounding air. Space is not warmed by the sunbeam, neither do rays of heat always elevate the temperature of the medium through which they pass; but the heat that is in the earth tends to diffuse itself equally among surrounding bodies; and it is this latter condition which plays so much havoc with metallic surfaces. The air surrounding iron cases taking heat from the earth causes the temperature of the metal to rise and the heat contained in the metal is transmitted to the air within the enclosure. Where wood is used to protect the apparatus, the warm air on the outside

affects the wood very slowly. In consequence of this obstruction or insulator, the air within is heated gradually, thereby allowing the metal parts of the apparatus to warm at the same rate. It is evident, therefore, that it is not, as is generally supposed, the fault of the cold wave that frost interrupts signal operations; it is the sudden rise in temperature. The temperature of the metallic parts within the case is considerably below 32 deg. F., and the air within the enclosures as well as that surrounding them rises rapidly.

The mechanisms being separated from the sides of the cases by bodies of air, remain at the lower temperature until the air can warm them. The moisture is precipitated because the heat of the air is abstracted and transmitted to the metal, and when it touches the metals, it is frozen and sticks there. If the rise in temperature continues, this frost is reconverted into water, and not infrequently large drops are seen to have been formed on all metals within the enclosure. The metals most affected are copper, steel and cast iron. Platinum, German silver and composition metals will be considered in connection with relays.

Where these sudden rises in temperature are followed by rapid declines, say, 30 deg. to 40 deg. within a few hours, the warm air, having already absorbed some moisture from the outer atmosphere, seems to be incapable of collecting all the moisture from the various metal parts, and as soon as the decline sets in, a portion of the moisture contained in the air, within the enclosure, is precipitated and deposited on the same parts. The entire quantity, seemingly so very little, freezes into ice and not infrequently causes important moving parts of the mechanism to be frozen together, making them immovable. It usually requires three to five hours for the metals to heat so that their temperature will correspond with that of the air. This is readily demonstrated by opening the enclosure and noting how quickly the frost is dissipated by air rushing in. If the deposit is light, it will disappear almost instantly; now restore the original condition by intercepting the means of ventilation and wait about thirty minutes; and, unless the temperatures are alike, in the air and the metal, frost will again be formed.

Interruptions due to this frosty condition have been found, from close observation, to be confined principally to the months of November, December and January. Slight frost conditions are noted at a few scattered signals during October and February. Most of the trouble, as already shown, is experienced with signals in regions where the air is heavily charged with vapor.

Again, it is found that the location of the sun enters largely into these frost conditions. It is an interesting fact that frost troubles are only heard of during the winter solstice. This is due to the shorter time that the sun is above the horizon during that season, which means but little heat radiated to the earth.

Though the conditions here enumerated appear to be beyond check or control, many efforts have been made to anticipate the accumulation of frost and ice, and with more or less success. The first practical design of an enclosure for protecting automatic block signal mechanism from interruption by the elements was put in service as early as 1866. This design is the pioneer of the enclosed disk, or "banjo" signal case of to-day. There are now two distinct designs of these cases: The one is built up each side, of two thicknesses of narrow boards with an iron frame surrounding them; the other is of sheet iron exclusively. Ten years' practice substantiates the claim that both are storm-proof.

The operating and controlling electro-magnets and the disk are contained in these cases; in a number of installations, the lightning arrester and also the track relay are located therein. This is done to simplify the installation and facilitate inspection.

Where but one case is used to give the required indication, it is usually placed on top of a hollow iron mast; where two cases are required, as for a home and a distant signal at the same point, they are placed on brackets which are bolted to the sides of wood or iron masts.

There are but few moving parts to the mechanisms contained within these cases, and it is due to the simplicity of construction and control, that there is so little interruption to their perfect operation. Instances are, however, on record where ice has formed between the revolving armature and its pole pieces, causing the disk to remain in the position occupied at the time of freezing. The excess of moisture in these cases is small for several reasons. First: The case is always situated some distance above the surface of the ground, which gives it the benefit of air freely circulating around it. Second: The small amount of metal surface and the presence of a large quantity of air reduces the amount of precipitation. Third: Where the case is of wood, a poor conductor of heat, the temperature within is raised slowly.

The exposed or "clock work" disk signal is designed so as to require the use of a hollow iron post, the mechanism, case and disks being located on the top of same. The gears, armatures and controlling electro-magnets, as well as the contacts for controlling the circuits, are placed within a square cast iron enclosure just below the disk. This signal, as the name implies, is operated by means of a weight, which is suspended within the hollow post.

Frost causes serious interruptions to the proper operation of these mechanisms. In addition to clogging the gear, the accumulation of ice will prevent the revolving of the disk by freezing the main vertical shaft to the bearing. Most of the trouble from frost is caused by the mechanism being set directly over the hollow post which allows communication with the earth.

In the electro-pneumatic semaphore signals, as originally designed, the only apparatus which are protected from interference by the elements are the electro-magnet and the valve which controls the supply of air used to set the semaphore arms in the proceed position. In more recent installations, the balance levers and vertical rods which work the arms have been placed within cast iron enclosures. Frost does not appear to interfere with this mechanism, but the condensed moisture in the valve sometimes freezes and prevents its prompt operation.

The earlier types of the electric semaphore were worked by outside connections. There are still in use many of this type. The motor and mechanism are in a box on a bracket sufficiently far down from the top of the post to allow the convenient operation of the balance lever. Although set high above the surface of the ground, these motors and their mechanism are frequently interrupted by frost. They are enclosed in a metallic case fairly well ventilated. This mechanism usually consists of a motor driving a drum to wind—a cable to raise the balance lever. The frost makes trouble by accumulating on the motor commutator enough to insulate the brushes; it also forms in such quantities as to clog the gear.

In the Union and the Hall electric semaphores all of the apparatus, including motor, gears, slots, clutches, relays and lightning arresters, are contained within an iron box fixed at the base of an iron mast, which contains the vertical rods. There are several important details to be considered in connection with these installations; one of the most important being the design of the mechanism case.

The latest design of a cast iron mechanism case now in use is so arranged as to allow no room for a battery, the base of the case being bolted directly to a concrete foundation. In this arrangement, the dash pots are also set on the concrete, the motor, its mechanism and the controlling electrical parts being mounted on a wooden or cast iron shelf some distance above the dash pots. The dash pots are frequently frosted and the return of the arm to the stop position is somewhat delayed. The mechanisms gather large quantities of frost and sometimes ice; there is one case on record where there was sufficient of the latter to prevent its operation. The part most susceptible to frost is the motor commutator. It is subject to most interruption when it has no covering of any kind to prevent the air coming directly in contact with it; the frost will insulate the brushes, thereby preventing rotation. The precipitation of moisture on unprotected commutators is sometimes anticipated by applying a coating of oil. This is partially effective; it will act as a preventive in the milder cases. A better way to anticipate this interruption is to cover the commutator with flannel or felt; this overcomes many petty interferences from frost; but extreme cases arise and this also fails.

These iron cases are ventilated on two sides. The air is allowed to circulate through these two openings (about 1½ in. in diameter, suitably protected outside to prevent storms from beating in), and if there is enough wind to keep the air within in circulation, the accumulation of frost will not be troublesome. This means of preventing the moisture in the air from precipitating is satisfactory until the draft ceases and then the difficulty reappears. A number of plans to successfully ventilate several hundred of this design of mechanism cases by means of a draft have thus far failed.

The later designs of iron posts have a mechanism case and a battery case bolted together. These cases are built up from cast iron frames, and are covered with sheet iron. The battery case is bolted directly to the concrete base. These cases have no ventilating openings. Mechanisms in them do not show any less accumulation of frost than in cast iron. Most of the motors in these have their commutators covered either by glass or a combination of celluloid and brass. In ordinary circumstances this is quite effective, but extraordinary frosts still cause interruption. Scientifically there is but one sure relief; that is to keep the air circulating. There is a second remedy if it could be carried out; that is to keep the air dry. Of the first solution, it may be said that a number of plans to create a draft have been tried and appear to be hopeless failures. If one deems the expense justifiable, well-made fan motors within the enclosure, operated from a battery, would be effective. If a fan is kept in proper working order, it will prove an absolute success; this has been demonstrated. As to keeping the air free from moisture, many things have been tried, some of the most interesting being sulphuric acid, ordinary burnt rock lime, and chlorate of lime. Heat, provided by hot water apparatus, thermal coils and kerosene oil lamps, has also failed. In several cases the lamps increased the trouble by promoting the formation of ice. At one time, the experiment was carried so far as to build large fires on the ground near the case in an effort to dry the air, but it proved fruitless. Lining these iron cases with white pine boards appears to have given some relief. Lining with hair insulator also assists very materially in the reduction of the interference.

The gas signals, operated by liquid carbonic gas, are placed in iron mechanism cases to which is bolted a sub-case for the battery, both cases being surmounted by the iron signal mast, the design corresponding with the one built of sheet iron and previously described. In some localities frost is deposited on these mechanisms; it takes, however, an extreme case to interrupt its operation. The properties of this gas are such as to insure perfect freedom from freezing. If, however, there is moisture in the gas, there is likely to be freezing at the valve, thereby causing failures in operation. The gas (if perfectly dry) exhausting from the cylinder, after the signal has been set to the proceed position, absorbs whatever moisture there may be in the enclosure, thereby decreasing the chance that frost will accumulate.

Electric Railroads in Ohio.

The *Street Railway Journal* reviews the progress made by the street railroads in Ohio. Ten syndicates operate about 1,700 of the 2,917 miles of electric road within the State. These syndicates and the mileage they work, classified according to whether it is interurban or city, are as follows:

Name.	Interurban.	City.	Total.
Everett-Moore	272	195	414
Elkins-Widener	141	226	367
Pomeroy-Mandelbaum	250	...	250
Andrews-Stanley	...	220	220
Tucker-Anthony	163	20	183
Appleyard	142	16	158
Winters-Clegg	80	40	120
Allen-Stone	110	...	110
Columbus Railway & Light	8	98	106
Scrugham	101	...	101

The gross earnings of electric roads for the year ending April 30, 1903, according to reports filed with the Auditor of State, these being the latest figures obtainable, were $18,927,250. Of course, this is on a considerably smaller mileage than is in operation at the present, since a number of roads were placed in operation last year, and their earnings did not figure at all in this total. It should also be considered that several roads were placed in operation late in 1902, hence, did not figure for an entire year, neither were they up to their full earning power, on account of only partial operation in many cases. But it is safe to say that Ohio roads earned $20,000,000 in 1903.

It is manifestly impossible to separate the earnings of the city roads from those of the interurbans, because a number of companies operate and figure both together, but it is interesting to note that as, indicated by the following table, the city roads of the five leading cities of the State, with less than one-fourth the total mileage, earned over one-half the total gross receipts:

City.	Earnings.	Mileage.
Cleveland	$4,500,000	220
Cincinnati	3,500,000	210
Toledo	1,500,000	102
Columbus	1,200,000	106
Dayton	785,000	63
Total	$10,985,000	701

The handling of freight and express is beginning to prove quite an important item in the earnings of some of the electric roads of Ohio, but as a general proposition it can only be considered as being in its infancy. Forty-one companies engaged in either one branch or the other during the year ending April 30, 1903, and the total receipts from both sources were $343,735. The largest earnings were made by those companies that handled freight at freight rates, rather than express, which tends to refute the growing impression that the earnings are larger where goods are handled as express at express rates. The showings of some of the best of the freight and express handling roads are shown in the accompanying table:

Name.	Gross.	Freight.	Expr's.	Both.
Fairfield Tr. Co. (Lancaster)	$10,600	$5,200	...	...
Eastern Ohio Traction	197,000	44.000	...	...
Toledo & Western	122,000	23,000	...	...
Cincinnati, Dayton & Toledo	482,000	2.700	$11,000	...
Cleve., Painesville & East	231,000	...	10,000	...
Cin., Georget'n & P'tsmouth	130,600	37,500	10,200	...
Cleve. & Southw'n Tr. Co.	382,700	10,000	7,200	...
Col., Buckeye Lake & Newark	130,500	...	3,600	...
Col., London & Springfield	119,900	...	3,200	...
Col., New Albany & Johnst'n	21,600	1,900	...	...
Dayton, Covington & Piqua	54,200	2,300	...	...
Dayton & Northern	96,900	9,300	...	...
Dayton, Springfi'd & Urbana	195,600	...	11,350	...
Dayton & Troy	117,700	4,700	...	...
Dayton & Western	80.200	7,400	...	...
Dayton & Xenia	98,900	3,500	...	...
Lake Shore Electric	494,000	26,200	4,700	...
Mahoning Valley Ry. Co.	411,000	12,200	...	...
Maumee Val. Ry. & Light Co.	75,300	3,800	...	...
Newark & Granville Ry.	63,500	1,300	...	...
Northern Ohio Tr. & Lt. Co.	727,000	...	...	$15,800
Ohio Central Tr. Co.	60,700	1,500	...	...
Ohio River El. Ry. & P. Co.	45,400	...	...	2,900
Canton-Akron Railway	293.000	...	2,900	...
Pennsylvania & Ohio Ry.	73,000	...	2,200	...
Tiffin, Fostoria & Eastern	47,400	...	...	3,100
Toledo, Fostoria & Findlay	59,000	2,064	...	...
Tuscarawas Tr. Co.	56,800	2,500	...	...
Western Ohio Railway	121,000	...	3,800	...
Youngstown & Sharon	112,200	...	...	3,700

The Swiss State Railroads earned in 1903 about 1½ per cent. more gross, but 9 per cent. less net than in 1902. The various claims for improved service and better treatment of employees which the companies did but the State did not resist, have naturally resulted in a considerable increase in expenses. The Gotthard Railroad, the only important Swiss line still worked by a company, earned net 5 per cent. more in 1903 than in 1902.

TECHNICAL.

Manufacturing and Business.

The Buffalo & Susquehanna Iron Co., of Buffalo, N. Y., has increased its capital stock from $600,000 to $1,000,000.

The Climax Railway Supply Company, Chicago, has received an order for "Climax" posts from the Erie for use in marking property lines.

The Ralston Car Co., Chicago, has been incorporated in Illinois with a capital of $75,000, to make cars, by E. D. Frazer, A. G. Miller and T. W. Headen.

The Beloit Machine Works, of Beloit, Wis., maker of woodworking machinery, will add three buildings to its works, the largest of which will be 70 ft. x 200 ft.

George Henry Firth, Superintendent of the Firth Sterling Steel Company, of Demmler, Pa., a branch of the Thomas Firth & Sons' Steel Company, of Sheffield, England, died March 16, at the age of 47.

The Rapp Iron Works, New York City, has been incorporated, with a capital of $20,000, to make iron and steel. The directors are Wm. N. G. Watson, Joseph H. Claffy and Wm. J. Cox, all of Brooklyn.

The J. T. Terhune Machine Works, of Paterson, has been incorporated in New Jersey, with a capital of $50,000, to make machinery. The incorporators are J. Irving Terhune and others, of Paterson.

Fairbanks, Morse & Company, of Chicago, announce that they have engaged M. Greenwood, formerly Pittsburg manager for the International Steam Pump Co., to look after their steam pump business in Pittsburg territory.

Bids are wanted April 4, by the Water Commissioners of Binghamton, N. Y., for one horizontal high duty crank and flywheel pumping machine of 12,000,000 gallons daily capacity, with the necessary piping and tools. John Anderson is Superintendent.

The office of the Universal Railway Supply Company, Baltimore, Md., which was destroyed in the recent fire, is now at 322 North Charles street, Baltimore. The company is the southern representative of the Continuous Rail-Joint Company of America.

The Emergency Car Brake Company, of Cumberland, has been incorporated in Maryland with a capital of $50,000, to make car brakes and car fittings. The incorporators are Henry Fresh, C. G. Smith and others, of Cumberland, and Asa F. Speicher, of Somerset, Pa.

G. P. Altenberg, manager of the Foreign Department of J. A. Fay & Egan Company, Cincinnati, Ohio, is on his way to Europe. He will first visit England and then tour the Continent. He expects to be abroad several months. Letters to him should be addressed No. 31 Boulevard Haussman, Paris, France.

Ground has just been broken and contracts let for a 75-ft. addition to the new machine shop of the Hyatt Roller Bearing Co. Although it is only six months since their large shops were completed the demand for bearings has made it necessary to again increase the plant. The new addition will be of brick, two stories high. The ground floor will be fitted with modern heavy machine tools, while the second floor will be used exclusively for assembling automobile bearings. The buildings will be completed by May 15, 1904.

Mr. Philetus W. Gates and Mr. Henry W. Hoyt, respectively General Superintendent and Second Vice-President of the Allis-Chalmers Company, are about to retire from the management of that company. Mr. Gates was president and Mr. Hoyt secretary and general manager of the Gates Iron Works for 15 years prior to the incorporation of the Allis-Chalmers Company in 1901. They have long been identified with Chicago manufacturing interests and have taken an active part in all of the manufacturers' associations. The late P. W. Gates (father of Philetus W. Gates) was the pioneer manufacturer of the region west of the Alleghanies, having established his business in Chicago in 1842. From 1861 to 1871 the Eagle Works Manufacturing Company, of which he was president, employed about 1,000 men, and for those days it was an enormous industry. In 1871 the Eagle Works Manufacturing Company went out of existence and from it were organized the Gates Iron Works and Fraser & Chalmers, each taking a portion of the business. Both of these companies in turn were taken over by the Allis-Chalmers Company in 1901. Messrs. Hoyt and Gates, after a well-earned vacation spent in traveling, will reengage in business in Chicago.

Iron and Steel.

The Baldt Steel Co., maker of steel castings, will have its new works at Newcastle, Del., in operation about May 1.

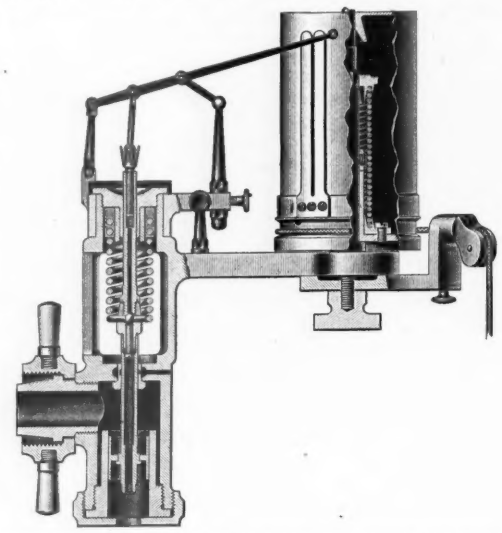
The Juniata Steel & Iron Co., of Greencastle, Ind., has increased its capital from $50,000 to $500,000. F. M. Lyon is Secretary.

It is announced that the Alabama Steel & Wire Co. will have its steel works at Gadsden, Ala., in full operation in May, and that its steel rod, wire and nail mills at Ensley, Ala., will resume operation, after an idleness of nearly a year, about the same time.

A marked improvement is reported in the iron and steel trade. Sales of pig iron for the past two weeks are about double those of any similar period since December, 1902, when prices were $8 a ton higher. The contracts for 25,000 tons of steel plates and 300,000 tons of castings to be used in building the Pennsylvania tunnels, will soon be let, and certain parts of the work will be competed for by the Pennsylvania Steel Co., the Bethlehem Steel Co., the United States Steel Corporation and the Cambria Steel Co. It is also reported that the New England foundries have formed a pool to bid against the central and western companies for the castings contract.

An Improved Steam Engine Indicator.

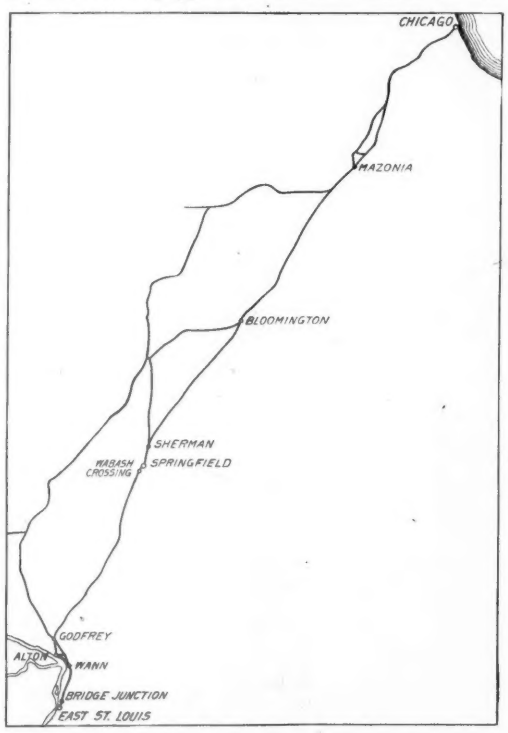
Owing to the extreme high pressures carried at the present time, the Bureau of Steam Engineering of the United States Navy Department has decided that, hereafter, all indicators used by them shall be of the outside-spring type. To meet this demand, the Star Brass Manufacturing Company, Boston, Mass., has designed the indicator shown



herewith. The drum, pencil motion, etc., remain the same as in their regular inside-spring type. The area of the piston has been reduced to ¼ sq. in., which allows the use of a much lighter spring. The spring is elongated instead of compressed and it is claimed that this arrangement prevents buckling and thus diminishes the friction of the piston in the cylinder. The operation of the pencil movement is directly opposite to that used in the inside spring types so that the atmosphere line is at the top of the drum instead of at the bottom. The steam connection is at the side instead of at the bottom. The piston can be easily removed for oiling or inspection by unscrewing the cap at the bottom. It is claimed that the weight of the moving parts in this indicator is no greater than that of the ordinary inside-spring type.

The Block System on the Chicago & Alton.

As recently announced, the Chicago & Alton, in preparation for the increased business of the coming summer between Chicago and St. Louis, is making arrangements to use the block system regularly for all trains throughout the line between those two cities, 280 miles. Parts of this line have been equipped with automatic signals for several years; on other parts the space interval has been enforced in foggy weather by the train despatchers. The permanent arrangements now being made are outlined by an officer of the road as follows:



Between Chicago and Mazonia, a distance of 62.4 miles, there is a complete automatic block system; between that point and Godfrey, a distance of 189.6 miles, automatic signals are provided only for the protection of certain points, and between Godfrey and Wann, a distance of 10 miles, the old main line via Alton is equipped with automatic signals. Between Godfrey and Wann via the cut-off the staff system is used. Between Wann and Bridge Junction (East St. Louis) the main tracks of the Big Four and the Chicago & Alton roads are used together as a double track railroad. This section, which is 18 miles long, is worked by telegraph block system and trains are not classified, being governed entirely by the block signals. These are in charge of a train despatcher at Bridge Junction who has no other duties except to attend to the movement of trains between Wann and Bridge Junction.

The telegraph block signal system which is to be established between Mazonia and Godfrey will be worked (on the single-track parts) for the protection of opposing trains as well as trains running in the same direction, and the automatic signals will be used as an auxiliary. Between Mazonia and Bloomington, 64.1 miles, the road is double track, and between Bloomington and Sherman, 51 miles, it is single track. Between Sherman and Wabash Crossing, 9.7 miles, it is double track and fully protected by automatic signals; between Wabash Crossing and Godfrey, 64.8 miles, it is single track with occasional automatic signals, where the view is obscure.

Belgian Railroad Exhibit at St. Louis.

The Belgian State Railroads are to exhibit at St. Louis four complete miniature trains, consisting of models of the different kinds of cars and locomotives in use in Belgium since 1835.

Pneumatic Tubes for St. Louis.

The United States Postoffice Department, on the recommendation of the various postal officials interested, has accepted the offer of the Union Terminal Co., of St. Louis, to build a station 20 ft. x 70 ft. on land owned by the company at the Eads bridge for housing the pneumatic tubes through which the mails will be conveyed between that point and the St. Louis post office.

Berlin-Zossen Speed Trials.

The organization which made the experiments with high speeds on the military railroad near Berlin has determined to resume them, chiefly to ascertain the effect of long-continued use of the appliances at high speeds. The line (14 miles) is too short to be altogether satisfactory for such experiments, but it is already fully equipped and the use of it can be had for several hours a day.

Large English Westinghouse Contract.

The British Westinghouse Electric & Mfg. Co. has secured the entire contract for the lighting and power plant, cranes and other equipment for the new docks at Heysham Harbor, Lancashire, building by the Midland Railway. The Midland is spending approximately $18,000,000 on the construction of these docks in connection with its new Irish steamship service, and the Westinghouse contract is said to be worth upwards of $250,000.

A Test of "Thermit."

The Pennsylvania recently made a test of "Thermit," the new welding compound introduced in this country by the Goldschmidt Thermit Company, New York. The riser from the weld of a steel locomotive frame was drawn out under a hammer into a bar about 3 ft. long and turned down and broken. The tensile strength was 91,600 lbs. per sq. in., the elongation was 21.5 per cent. in 8 in. and the fracture had a silky appearance. The mixture contained 2 per cent. of pure manganese free from carbon and 5 per cent. of iron punchings. The chemical analysis was as follows: Carbon, .102 per cent.; manganese, 2.33 per cent.; phosphorus, .07 per cent.; silicon, 1.2227 per cent.; sulphur, 0.34 per cent.

An Induced-Draft Plant for a Hotel.

The American Blower Company, Detroit, Mich., has recently installed in the Hotel Royal Poinciana, Palm Beach, Fla., an induced-draft plant which is the third of a similar character built for the Florida East Coast Hotel Company. The apparatus is mounted on a steel platform above the boiler room floor, to save floor space, and consists of two fans placed end to end and both delivering into a 60-in. steel stack, which extends through the roof only 22 ft. above the fan outlets. Each of these fans is known as a 160-in. fan, with a special full housing and a wheel 108 in. in diameter. They are designed to furnish draft for five 78-in. by 18 ft., and one 78-in. by 20-ft., horizontal tubular boilers, the former having each a grate area of 39 sq. ft., and the latter an area of 42½ sq. ft. The pressure is 120 lbs., the fuel being buckwheat anthracite. Each fan is designed for a normal speed of 250 r. p. m., but can be speeded up to 300 r. p. m., and at the maximum speed the two fans will produce sufficient draft to force the boilers 15 per cent. over their rated capacity. The apparatus is designed for a normal draft of 1.5 in. of water and a maximum pressure of 2 in. At normal speed each fan handles 22,000 cu. ft. of gases per minute at a temperature of 550 deg., and under these conditions each fan requires 10 brake h. p. for its operation.

The fans are driven by American Blower Company's direct-connected high-speed vertical engines, having 7-in. x 7-in. cylinders and are of the balanced piston-valve crank-center type. The wheel is overhung on the end of the engine shaft. The engines have large wearing surfaces and an improved system of lubrication which permits of long and continuous runs with little attention. The crank shafts are of forged steel and turn in long and well babbitted bearings. Each engine has an automatic regulating valve which increases the fan speed and draft as the steam pressure falls, and vice versa. The stack is made of No. 10 sheet steel, and is arranged to be self-supporting on the outlets of the fans. The steel platform is built of six vertical 8-in. I-beams, with a superstructure of 10-in. and 6-in. I-beams. This plant is giving good results.

THE SCRAP HEAP.

Notes.

The railroads terminating in Chicago have been asked by the Interstate Commerce Commission to file complete statements of all their divisions of rates with, and other allowances to, so-called terminal roads.

It is announced that the New York Central and the Big Four will this summer run a new express train between New York and Chicago daily in about 25 hours. This is about four hours quicker than the best time now made.

According to a Western paper the traveling agents of the St. Louis & San Francisco have been notified that hereafter the auditor will not approve bills for expenditures made by them for wine for persons with whom they do business.

The railroads from Buffalo to New York and Philadelphia announced on Monday last that wheat would be carried from Buffalo to the seaboard at one-fifth of a cent a bushel; and equally ridiculous rates were quoted on other grains; but the actual movement of grain in any considerable quantity is yet to begin.

The Legislature of Iowa, sympathizing with the drovers who have been deprived of their return tickets from Chicago, has passed a bill requiring the railroads to furnish them and their agents passes to the destination of their stock shipments, and back, and within one year to provide toilet accommodations in all cabooses.

The United States Circuit Court of Appeals, at New Orleans, has affirmed the decision of the Circuit Court for the Northern District of Texas, denying the right of the State Railroad Commission to make regulations for the handling of export grain at Fort Worth, where the Rock Island road transfers such grain to the elevators of the Rosenbaum Grain Company.

At Memphis, Tenn., the other day, a box car of the Baltimore & Ohio, of 100,000 lbs. capacity, was loaded with 1,833 bushels of wheat, and it is claimed that this is the largest quantity of wheat ever loaded into a car. As this quantity of wheat would occupy a space of nearly 2,300 cu. ft., it would fill a standard 36-ft. box car up to within about 6 in. of the roof.

Judge Thayer, of the United States Circuit Court of Appeals at St. Louis, has overruled the demurrer of the ticket brokers, and the injunction against 30 brokers of that city which was issued on the application of the principal railroads last October, continues in force. At Buffalo, on Monday last, Charles H. Callahan, a ticket broker, was sentenced to State's prison for one to three years for forgery.

The United States Supreme Court on March 21 again decided a question concerning claims for damages made by persons traveling on railroads on passes, and the decision went to the extent of applying the principle to such passengers who are not familiar with the contract usually printed on the back of passes. The case decided was that of Boering vs. the Chesapeake Beach Railway. Mrs. Boering was injured in an accident while traveling on a pass issued to herself and her husband, containing the usual stipulation of exemption from damage. It was urged that she had not been made aware of the stipulation, and that the company was liable on account of her ignorance. The court did not accept this view.

The "Lapland Limited," which ran once a week last summer between Stockholm and Narvik, the Norwegian harbor within the Arctic zone, did not pan out very well. It made nine round trips, and carried 187 passengers north (29 on free passes) and 71 south (18 on passes), or an average of 21 north and 8 south per train. It is intimated that a railroad trip 1,366 miles long through a country not particularly interesting for the most part is not found attractive, and that the tourists to the North Cape and the midnight sun prefer the comfort of the steamers and the magnificent Norway coast. A combination with a steamer line is suggested, by which the North Cape pilgrims should make the journey one way by steamer and the other by rail and steamer, which would reduce the time somewhat.

The $2 charge on cars of live stock delivered to the Chicago stock yards is again the subject of a deliverance from the Interstate Commerce Commission. On March 21 the Commission announced its decision in the case of the Cattle Raisers' Association of Texas, complainant, and the Chicago Live Stock Exchange, intervener, against the Chicago, Burlington & Quincy and other railroads. The Commission holds that the statute of limitations does not apply to the suit of the members of the association for damages and defines the procedure to be followed in procuring reparation through the Commission. The complainant and the intervener are given leave to show to what territory the through rate reduction of 1896 applied, and if it appears that there was territory to which such reduction did not apply and from which no reduction has been made defendants will be allowed to show, since conditions may have changed subsequent to the making of the original order, that the through rate from that territory is reasonable and just notwithstanding the addition of the terminal charge of $2 per car in Chicago. Upon proof damages will be allowed in favor of members of the Cattle Raisers' Association of Texas of shipments from all territory down to the reduction in through rates of 1896, and from territory to which that reduction did not apply down to the date of hearing to be had in relation thereto. The act to regulate commerce in conferring authority upon the Commission to award damages in cases brought before it, such award amounting merely to a recommendation, is declared to be valid. By its original decision the Commission declared that a terminal charge of $2 per car on live stock for delivery to the Union stock yards was unlawful, that any such charge exceeding $1 per car would be unlawful, and continued the case for proof of damages to injured parties. The decision of the United States Supreme Court authorized the Commission to take further proceedings to correct any unreasonableness in the rate resulting from the additional terminal charge as to any territory from which the railroad had not made a reduction.

Proposed Railroad in Nicaragua.

The Government of Nicaragua is making location surveys for a railroad from San Miguelito, on the southeast shore of Lake Nicaragua, to Monkey Point, on the Caribbean Sea. It is reported that the route is favorable for railroad construction, especially the eastern half. The road is projected, however, through a region where the population and the through traffic will pay only a low rate of interest on the cost. President Zelaya, of Nicaragua, is determined to build the railroad, if possible. It is stated that the line can be completed in about two years if sufficient capital is obtained to finance the work. —*Consular Report.*

N. Y. Board of Trade and Transportation

The Directors of the New York Board of Trade and Transportation oppose arbitration in the fight which Philadelphia is making against differential grain rates from Buffalo to New York and Philadelphia. It is alleged that these differentials have existed for twenty-two years and have discriminated against the port of New York to its hurt. Arbitration of the question means giving to others the power to fix for New York a rule determining arbitrarily how much of the commerce that is naturally tributary to New York shall be artificially diverted to other cities. The Directors hold that New York should stand invincible upon its natural and acquired advantages, and they protest against any arbitration by which any decision other than the total abolition of differentials may be reached.

Maryland Separate-Car Law.

The Governor of Maryland has approved the two so-called "Jim Crow" bills relating to railroad and steamboat travel in the State, and the acts will go into effect. The railroad bill requires separate cars to be provided for colored passengers except on express trains and trains with Pullman cars attached. It excludes from its operations employees of railroads, nurses and officers in charge of prisoners. It does not include electric or street cars. The steamboat bill provides for separate compartments for white and colored passengers, but there must be no discrimination in the quality of accommodations.

Politics and the Race Problem.

The hope that Governor Warfield would veto the "Jim Crow" bill passed by the Maryland Legislature, and thus check the tendency toward unhappy race discriminations, has been strong. It is disappointing, therefore, to learn that he has signed one of the most radical separation laws ever proposed in the South. By the new law, every railroad and steamship company—by which is meant ferries principally—is required to provide "Jim Crow" compartments, and rigidly enforce the segregation of the races. That the negro has fallen a victim to the political ambitions of the senior Senator from Maryland is plain to be seen. This ready sanction by the Governor of the "Jim Crow" law would indicate that Maryland and Mississippi must be bracketed as infected States, and that Warfield, urged on by Gorman, must be classed as a Governor fallen ill of negrophobia.—*Evening Post* (New York).

Railroads in Shan-Tung.

One of the most important railroads in China is that which the Germans have built in the province of Shan-Tung and over 252 miles of which the first regular train ran, March 15. This province occupies a peninsula south and east of Pekin, densely populated and less exposed to inundations than the country further south. The railroad leaves the coast at Tsin-tao, which has not been an important port, and it extends in a generally western direction to Tsi-nan-fu, a great center of the silk trade, and reaches coal mines which the promoters of the railroad consider of great importance. Near Tsi-nan the railroad is to meet another railroad which runs from Tien-tsin, the port of Pekin, south through Shan-tung and thence southeast to Shanghai. This line was conceded to a German and English combination, but it is reported that the Germans have withdrawn, and that the English will build the railroad. The company which has built the German railroad to Tsi-nan has a concession for another line which will make a great loop, further south and longer than the road already built. This does not seem likely to serve as an outlet to other parts of China, but the province of Shan-tung should yield it a very heavy traffic. The western terminus, Tsi-nan, is on the great Hoang-ho River, but this ranks something like the Missouri as a navigable stream.

An Engine With a Good Digestion.

Engine No. 264 has returned from California and she has pulled into the Texas & Pacific roundhouse and reported no repairs after a trip of 5,000 miles. Forty different kinds of coal were fed into her fire-box and water of every known analysis run into her boilers and yet the only attention needed by the big compound was the tightening of a nut here and there or the turning of a valve done by the crew en route. This trip was made by the engine and her crew in pulling the Gould special with her party of officials from this State west to the Pacific coast, and then back to Little Rock, where they were taken toward the east over the affiliated eastern lines. Picking up the special at Big Springs, on the Rio Grande Division of the Texas & Pacific, this one engine pulled the 6-car special over the entire distance to Little Rock and in all the trip was laid up at no place for repairs. Starting on the run on February 25, the engine, during its course, reflected the fever heat of the plains well up into the 90's and bucked snow in the Rockies; was 260 ft. below sea level in the Salt River Valley and 10,000 ft. above in crossing the Colorado divides; passed through the grinding dust of the deserts and between walls of snow. Gould, upon leaving at Little Rock for the trip east personally complimented both the men and gave them a substantial token of his appreciation in the shape of a purse apiece, each containing a hundred dollars in gold. The train which made the trip was composed of the private cars of George Gould, President E. T. Jeffery, of the Denver & Rio Grande, and General Manager L. S. Thorne, of the Texas & Pacific, in addition to an observation car and two baggage cars.—*Times-Herald*, Waco, Texas.

MEETINGS AND ANNOUNCEMENTS.

(For dates of conventions and regular meetings of railroad associations and engineering societies see advertising page 16.)

Canadian Society of Civil Engineers.

A meeting of the Electrical Section was held on March 24, at Montreal. The subject for discussion was "The Use of Electricity on Canals." Papers were read by Mr. L. A. Herdt on "The Use of Electricity on the Lachine Canal," and by Mr. F. H. Leonard, Jr., on "Electrical Equipment for the Cornwall Canal."

American Institute of Electrical Engineers.

The next meeting of this Society will be held in New York on the evening of March 25, at which the subject for discussion will be High-Pressure Transmission. Introductions to discussions will be made as follows: The Relative Fire-Risk of Oil and Air-Blast Transformers, by E. W. Rice, Jr.; Use of Group-Switches in Large Power Plants, by Lewis B. Stillwell; Oil Switches for High Pressure, by E. N. Hewlett; Terminals and Bushings for High-Pressure Transformers, by Walter S. Moody.

American Society of Mechanical Engineers.

The Chicago meeting of this Society will begin May 31 and will probably end on June 3. This meeting is to be a joint session of the American Society of Mechanical Engineers and the Institution of Mechanical Engineers of Great Britain. This latter body holds an American meeting this spring and by invitation of the Council, makes its American meeting a joint session with the Society at its Chicago meeting. Nearly two hundred members of the British Institution will take part in this joint meeting and visit the St. Louis Exposition, also make excursions to points of technical and manufacturing interest all through the United States. Among the subjects of papers to be presented at the Chicago meeting by the British Institution will be the Steam Turbine, the Gas Engine, Motor Cars, Hydraulic and Electric Cranes, Induction Fans and Garbage Destructors. The Committee on Meetings has decided to ask for papers on the American Steam Turbine, American Gas Engine, the Power Plant of the Tall Office Building, the American Locomotive Testing Plant, the American Shop Management Problem, the Modern American Machine Tool, and others. It will not ask for contributed papers from the members on any other subjects than these, with a view to limiting the number of papers to be read and giving the greatest available time for extended discussion.

PERSONAL.

—Mr. A. R. Merrick, whose promotion to the Superintendency of the Saginaw District of the Pere Marquette was recently announced, was born at Port Austin, Mich., in 1874. He began railroad work on the Pere Marquette at the age of 17 as a passenger brakeman, and has served on that company's lines ever since. In 1892 he was transferred to the freight service, and in 1896 was made freight conductor. Five years later he was made passenger conductor, and in March, 1902, was promoted to be Trainmaster of the Toledo Division. In June, of that year, he was again transferred to the Ludington Division, and the next year (1903) he took charge of the Chicago Division, from which position, on March 8, he was promoted to succeed Mr. Stillwell as Superintendent of the Saginaw District.

—Mr. Charles H. Markham, President of the Houston, East & West Texas, who has been appointed General Manager of the Pacific System of the Southern Pacific, has been in the service of this company and its allied lines

since 1881. He was born at Clarksville, Tenn., in 1861, and began his railroad service as a section laborer on the Atchison, Topeka & Santa Fe. In 1881 he entered the service of the Southern Pacific in New Mexico and was successively station agent at Deming, N. Mex.; Lordsburg, N. Mex.; Benson, Ariz.; Reno, Nev., and Fresno, Cal. In 1897 he was promoted from his Fresno position to be General Freight and Passenger Agent of the Oregon Lines. Three years later he was made First Vice-President of the Galveston, Harrisburg & San Antonio, and soon after was elected President of the Houston, East & West Texas and the Houston & Shreveport.

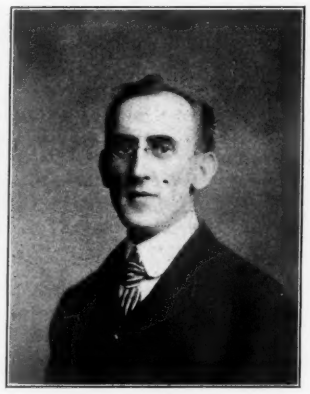
—The new Mechanical Engineer of the Central Railroad of New Jersey, Mr. B. P. Flory, is a native of Pennsylvania, having been born in Susquehanna, November 9, 1873. He is a graduate of Cornell University, class of 1895, and before entering railroad service was, for about three years, a Draftsman for the Anaconda Copper Mining Company. His early railroad training was on the Lehigh Valley, where he began in 1899, as an inspector and he was later promoted to be Chief Draftsman. Shortly afterward he was made Mechanical Engineer. In June, last, Mr. Flory was transferred to the special staff on work pertaining to the Lehigh Valley Railroad's new shops at Sayre, which position he now resigns to go to the Central of New Jersey to succeed Mr. Wildin as Mechanical Engineer.

—Mr. A. S. Zinn, recently appointed Division Engineer of the Oklahoma Division of the Chicago, Rock Island & Pacific at Chickasha, has been for the last few years on the Vandalia Line, where he was at first Assistant Engineer of Maintenance of Way of the Michigan Division and later Assistant to the Chief Engineer at Terre Haute. Mr. Zinn's railroad service began on the Illinois Central in Iowa. He served also on the Pittsburg, Cincinnati, Chicago & St. Louis and the Elgin, Joliet & Eastern.

—Mr. Luke J. Ferritor, who succeeds Mr. Cotter at Peru, Ind., as Superintendent of the Eastern Division of the Wabash Railroad, was born at Athens, Ohio, and is 39 years old. He began work as a messenger boy and at the age of 14 was an operator on the St. Louis, Kansas City & Northern, now a part of the Wabash. Later he was made traveling agent, and still later he was an operator in the Trainmaster's office of the Omaha Division of the Wabash. For a time he was Trainmaster and Chief Despatcher on the Omaha & St. Louis. In July, 1896, he went to Stratford, Ont., as Trainmaster of the Middle Division of the Grand Trunk, and two years later he was made Assistant Superintendent at London, Ont. In 1899 he was transferred to St. Thomas as Superintendent of the Southern Division of the Grand Trunk, and the Buffalo Division of the Wabash, from which position he is now promoted to that of Superintendent of the Eastern Division.

—Mr. Samuel Higgins, the new General Manager of the New York, New Haven & Hartford, was born in San Francisco, Cal., February 19, 1860; was graduated at the Sheffield Scientific School of Yale University in 1881; took a position immediately in the service of the New York, Lake Erie & Western as machinist's apprentice, and from the foot of the ladder worked his way up to be machinist, assistant foreman, general foreman of the Susquehanna shops, Assistant Engineer of Motive Power (1885-1887), Division Master Mechanic (1887-1892), and Assistant Superintendent of Motive Power (1892-1894). He then went to the Lehigh Valley as Superintendent of Motive Power, remaining until 1901, and since then has served in the same position on the Union Pacific and later, until the present time, as Mechanical Superintendent of the Southern Railway. Mr. Higgins will take his new office early in April. His appointment is significant of President Mellen's plan of surrounding himself with comparatively young subordinate officers, and, more specifically, of giving direct attention to improvement of the somewhat antiquated freight rolling stock of the New Haven system and expanding the car and train load along the lines of his successful policy on the Northern Pacific.

—Mr. R. F. McKenna, who has been appointed Master Car Builder of the Delaware, Lackawanna & Western, with office at Scranton, Pa., was born in New York City, November 14, 1868. Mr. McKenna began his railroad service as an apprentice on the Delaware, Lackawanna & Western in 1884. In 1891 he was made Chief Draftsman in the car department. In 1892 he resigned and became Manager of the Buffalo Car Wheel Company, but left this company the next year to return to the Lackawanna as General Air-Brake Instructor and Foreman of the car shops at Scranton. In 1899 he was made General Foreman of the Eastern Division at Dover, N. J., where he remained until 1902, when he was appointed General Foreman on the Scranton Division. When Mr. Canfield, Master Car Builder, resigned in 1903, Mr. McKenna was promoted to the position of Superintendent of Car Shops, and now he is to be Master Car Builder. Mr. McKenna is President of the Car Foreman's Association of Scranton, and is also an active member of the Central Railway Club, the New York Railway Club, and others.



—Mr. M. R. Coutant, the new Master Mechanic of the Ulster & Delaware Railroad, has for the past year and a half been on the Erie Railroad. Mr. Coutant is a native of Aurora, Ind., and when a boy spent his vacations from school in the shops of the Ohio & Mississippi as a special apprentice. Later he entered the shops of the Indianapolis & St. Louis. Shortly afterward he went to work in the shops at McCourt, Miss., of the Jackson road (Illinois Central) as Draftsman and after five years here he served in similar positions in the offices of the Union Pacific at Cheyenne, Wyo., the Universal Car Truck Company, Chicago, the Wabash, the Louisville & Nashville and the Atchison, Topeka & Santa Fe. From here he returned to the Union Pacific as Mechanical Engineer. His service on the Erie dates from 1902, when he began as Master Mechanic at Susquehanna, where he had charge of the Delaware, Tioga and Jefferson Divisions.

—Mr. Julius Kruttschnitt, who goes from San Francisco to Chicago to become Director of Maintenance and Operation for all the "Harriman Lines," has for some time past been Fourth Vice-President, Assistant to the President and General Manager of the Southern Pacific, which means that Mr. Kruttschnitt has carried on most of the administrative duties of the President's office. He was born in New Orleans 50 years ago, his father having been German Consul at that port. He graduated from Washington and Lee University (Civil Engineer) in 1873. In 1878 he was engineer in charge of the extension of Morgan's Louisiana & Texas Railroad from Morgan City westward, carrying out the work as far west as Cheneyville. He later became roadmaster of the Western Division of that road, then Assistant Chief Engineer and General Roadmaster and finally Chief Engineer and Superintendent of the system. In 1885, when the Southern Pacific leased the road, Mr. Kruttschnitt was appointed Assistant Manager of the Atlantic System, and four years later he was made General Manager of that system. In October, 1895, he was made General Manager of all the Southern Pacific lines, taking up his headquarters at San Francisco, and later the additional titles of Fourth Vice-President and Assistant to the President were added. Mr. Kruttschnitt's jurisdiction, as Director of Maintenance and Operation of the "Harriman Lines," will extend over the Southern Pacific, the Union Pacific, the Oregon Short Line and the Oregon Railroad & Navigation Company.

—Mr. Charles R. Fitch, until about two years ago General Manager of the Erie Railroad, died at his home in Greenville, Pa., on March 18, of enlargement of the heart, at the age of 54. Mr. Fitch's railroad service dated from 1866. He was for several years Assistant Superintendent of the Long Island. In September, 1888, he was Superintendent of the Mahoning Division of the New York, Pennsylvania & Ohio (Erie), but in November of the same year he returned to the Long Island as Assistant Superintendent and Superintendent of Telegraph. Three years later he again went to the Erie and for one year was Superintendent of the Eastern Division of that road. In November, 1892, he was General Superintendent. In January, 1900, he was General Manager of the Erie (east of Salamanca) and the next year his jurisdiction was extended over the whole system. About two years ago he resigned and was for about one year on the Baltimore & Ohio, where he acted as confidential adviser to the management in the operating department. Mr. Fitch was one of the best examples of what is sometimes called the old school superintendent; who accomplishes results, who is popular with his subordinates and who has integrity and corporate loyalty. He was at his best when dealing directly with trainmen and stationmen and roadwaymen; but as he rose to higher places he appeared to be as well liked by subordinate officers as he had been by the men, and as efficient in his work. His frankness and directness made intercourse with him easy, but his stern sense of duty sometimes led him to put business first and gentleness second. Mr. Fitch leaves a widow, a son and a daughter, and many warm friends in the railroad service. He had been in failing health several months.

ELECTIONS AND APPOINTMENTS.

Arizona & Utah.—Allen E. Ware has been appointed Superintendent, with headquarters at Kingman, Ariz., succeeding N. W. Tarr.

Atchison, Topeka & Santa Fe (Coast Lines).—J. W. Walker has been appointed Superintendent at Fresno, Cal., succeeding A. D. Schindler, resigned. (See California Northwestern).

Buffalo, Rochester & Pittsburg.—John McGarvey has been appointed Superintendent of the Middle and Clearfield & Mahoning divisions, with headquarters at Du Bois, Pa., succeeding George F. Gardner, resigned. (See Gulf & Ship Island.)

California Northwestern.—A. D. Schindler, hitherto Superintendent of the Atchison, Topeka & Santa Fe, at Fresno, Cal., has been appointed Assistant to the President of the C. N.

Chicago & Alton.—G. K. Hatz has been appointed Master Mechanic, with headquarters at Bloomington, Ill.

Chicago & Eastern Illinois.—T. A. Lawes, Superintendent of Motive Power and Machinery at Danville, Ill., has resigned. It is said that J. W. Luttrell will succeed Mr. Lawes.

Chicago Great Western.—S. E. Stohr has been appointed General Freight Agent, with headquarters at St. Paul, Minn., succeeding S. O. Brooks. C. O. Johnson has been appointed Assistant General Freight Agent, with headquarters at Chicago, Ill., succeeding Mr. Stohr.

H. Earnest has been appointed Freight Auditor, with headquarters at St. Paul, Minn., succeeding J. A. McCaskey, transferred.

Chicago, Rock Island & Pacific.—R. R. Sutherland, hitherto Assistant Superintendent, has been appointed Superintendent of the El Paso Division, with headquarters at Dalhart, Texas, succeeding J. H. Conlen, resigned.

Delaware & Hudson.—F. B. Lincoln has been appointed Superintendent of the Susquehanna Division, with headquarters at Oneonta, N. Y., succeeding P. H. Connors, resigned.

J. T. McKee has been appointed Superintendent of Dining Service, with headquarters at Albany, N. Y.

J. R. Skinner, Assistant Superintendent of Motive Power at Oneonta, N. Y., has resigned.

Grand Rapids & Indiana.—B. H. Hudson has been appointed Engineer of Maintenance of Way, with headquarters at Fort Wayne, Ind.

Gulf & Ship Island.—George F. Gardner, hitherto Superintendent of the Middle and Clearfield divisions of the Buffalo, Rochester & Pittsburg, has been appointed General Superintendent of the G. & S. I., with headquarters at Gulfport, Miss., succeeding R. Morgan.

Long Island.—J. R. Savage, formerly with the Lackawanna Steel Company, has been appointed Chief Engineer of the L. I., effective April 1.

Louisiana & Arkansas.—F. A. Symonds, hitherto Shop Foreman, has been appointed Master Mechanic, with headquarters at Stamps, Ark.

Macon, Dublin & Savannah.—J. A. Streyer has been appointed General Freight and Passenger Agent, with headquarters at Macon, Ga. E. E. Williamson, Traffic Manager, has resigned, and that office has been abolished. Mr. Williamson resigns to become Commissioner of the Receivers' and Shippers' Association of Cincinnati.

New Orleans Terminal Company.—L. A. Jones has been appointed Auditor, with headquarters at New Orleans.

New York Central & Hudson River.—L. Van Allen has

been appointed Superintendent of Terminals, at Buffalo, N. Y.

Northern Pacific.—Announcement is made of the following appointments, which are to take effect some time in April: General Manager Thomas Cooper will succeed W. H. Phipps at Land Commissioner. H. J. Horn, now General Manager of the Northern Pacific coal lands in Washington and Montana, will succeed Mr. Cooper as General Manager. J. F. Menzies has been appointed in charge of the coal lands in the State of Washington, and he will work under the direction of Charles M. Levy, Assistant to the President. Robert Pettigrew becomes General Manager of coal lands in Montana, and will report to the President. Mr. Phipps resigns to go into private business.

A. D. Charlton, hitherto Assistant General Passenger Agent at Portland, Ore., has been appointed General Passenger Agent, with headquarters at St. Paul, Minn., succeeding C. S. Fee.

Seaboard Air Line.—A. J. Poole, hitherto General Foreman of the Americus Shops, has been appointed Master Mechanic, with headquarters at Savannah, Ga., succeeding J. J. Thomas, Jr., resigned.

Southern Pacific.—Julius Kruttschnitt, hitherto Fourth Vice-President, Assistant to the President and General Manager, has been appointed Director of Maintenance and Operation of all the "Harriman Lines," with office at Chicago. Mr. Kruttschnitt's jurisdiction will extend over the S. P., the Union Pacific, the Oregon Short Line, and the Oregon Railroad & Navigation Company.

J. F. Shaughnessy has been appointed Assistant Superintendent, with headquarters at Wadsworth, Nev., succeeding W. A. McGovern, transferred.

Charles H. Markham, hitherto President of the Houston, East & West Texas, and an officer of other Southern Pacific lines in Texas, has been appointed General Manager of the Pacific System of the S. P., with headquarters at San Francisco.

Union Pacific.—See Southern Pacific.

Western Maryland.—J. A. Shepherd, Superintendent of Transportation, having resigned, that office has been abolished and the office of Superintendent of Car Service has been created, with J. W. Smith in charge, with headquarters at Baltimore, Md.

LOCOMOTIVE BUILDING.

The Philadelphia & Reading is having six locomotives built at the Baldwin Locomotive Works.

The Chicago & North Western is considering the purchase of 12 passenger locomotives (4-4-2).

The Canadian Pacific has ordered 10 simple (2-8-0) locomotives from the Canadian Locomotive Works. These locomotives will weigh 180,000 lbs., with 157,000 lbs. on the drivers; cylinders, 21 in. x 28 in.; diameter of drivers, 57 in.; radial stayed wagon-top boilers, with a working steam pressure of 200 lbs.; National charcoal iron tubes, 2 in. in diameter; Canadian Pacific specification steel fire-box, 96 in. long and 65 in. wide, inside measurements; grate area, 43.6 sq. ft.; tank capacity, 5,000 imp. gals. of water and coal capacity, 12 tons. The special equipment includes: Westinghouse air-brakes, "Little Giant" bell ringers, Magnesia boiler lagging, Simplex brake-beams, Washburn pilot couplers for engine and Tower couplers for tender, Hancock injectors, U. S. piston and valve-rod packings, World safety valves, Wilson sanding devices, Ritters and Detroit sight-feed lubricators, Crosby steam gages, Crucible driving and truck wheel tires, Schmidt superheater, cast-iron tender wheels and cast-steel wheel centers.

CAR BUILDING.

The Grand Trunk has ordered 15 passenger cars from the Pullman Co.

The Darien & Western is reported in the market for 20 or 30 freight cars.

The Boston & Maine has ordered 15 passenger cars from the Pullman Co.

The Metropolitan West Side Elevated, Chicago, is in the market for 68 cars.

The Georges Creek Coal & Iron Co. (*B. & O.*) is asking prices on 200 coal cars.

The Pittsburg & Lake Erie is in the market for 1,000 100,000 lbs. capacity steel coal cars.

The Chesapeake & Ohio has ordered 11 miscellaneous cars from the American Car & Foundry Co.

The Philadelphia & Reading has ordered 100 refrigerator cars from the American Car & Foundry Co.

The Niles Boiler Works are having 15 freight cars built at the McKees Rocks Works of the Pressed Steel Car Co.

The Buffalo, Rochester & Pittsburg has ordered six coaches, one chair car and one combination cafe and parlor car from the American Car & Foundry Co.

The Butte, Anaconda & Pacific is having 75 freight cars built by the Standard Steel Car Co. These cars will be equipped with Westinghouse air-brakes and friction draft rigging.

The Harriman Lines are reported to be about to order a large number of freight cars, the figures ranging from 10,000 to 30,000. We understand that some freight and passenger cars will likely be ordered in the near future, but that the numbers will not be surprisingly large.

The Potosi & Rio Verde has ordered 30 narrow gage flat cars of 40,000 lbs. capacity from the Mt. Vernon Car Manufacturing Co., for March, 1904, delivery. The special equipment includes: American Steel Foundries Co.'s bolsters, Mt. Vernon Car Manufacturing Co.'s brake-shoes and wheels, Hewitt brasses, St. Louis Steam Forge & Iron Works axles, hickory brake-beams and Pittsburg Spring & Steel Co.'s springs.

The Seaboard Air Line, as reported in our issue of March 18, is asking bids on 500 plain box cars of 80,000 lbs. capacity, and 500 ventilated box cars of 60,000 lbs. capacity. The 80,000 lbs. box cars will weigh 37,500 lbs. and the 60,000 lbs. box cars will weigh 33,500 lbs. All cars will measure 36 ft. long, 8 ft. 6 in. wide and 7 ft. 6 in. high, all inside measurements. The special equipment includes: Steel axles, Westinghouse air-brakes, Ajax Metal Co.'s brasses, Tower couplers, Jones doors, Chicago roofs and arch-bar trucks.

The Colorado & Southern has ordered 700 box cars and 300 stock cars, all of 60,000 lbs. capacity, from the American Car & Fundry Co., for April, May and June delivery. The box cars will weigh 34,000 lbs., and measure 36 ft. long, 8 ft. 3½ in. wide and 7 ft. high. The stock cars will weigh 34,300 lbs., and measure 36 ft. 3 in. long, 8 ft. 10 in. wide and 7 ft. high. The special equipment for all includes: Carnegie steel axles, Bettendorf metal bolsters, Westinghouse air-brakes, Harrigan combination brasses, Climax couplers, Smith doors for box cars, Miner tandem draft rigging, Woodman journal boxes and lids, Railway Steel-Spring Co.'s springs and arch-bar trucks.

The Mobile & Ohio has ordered 625 box cars of 60,000 lbs. capacity; 500 drop-end gondolas, of 80,000 lbs. capacity, and 75 hopper-bottom gondolas, of 60,000 lbs. capacity, from the American Car & Foundry Co.; also 275 box cars, of 60,000 lbs. capacity; 200 drop-end gondolas, of 80,000 lbs. capacity; 150 stock cars, of 60,000 lbs. capacity, and 75 hopper-bottom gondolas, of 60,000 lbs. capacity, from the Mt. Vernon Car Manufacturing Co., for delivery in 60 days. The box cars will be 36 ft. long, 8 ft. 6 in. wide and 8 ft. high, all inside measurements. The drop-end gondolas will be 40 ft. long over end sills, 9 ft. 8 in. wide inside with 45-in. sides. The hopper-bottom gondolas will be 28 ft. long, 7 ft. 7 in. wide, with sides 6 ft. high. The stock cars will be 36 ft. long, 8 ft. 5¼ in. wide and 7 ft. 8 in. high, all inside measurement. The special equipment for all includes: Damascus brake-beams, Westinghouse air-brakes, Harrison sectional brasses, National Malleable Castings Co.'s door fastenings for box and stock cars, Jones doors for box cars, Block-Pollak open-hearth steel axles for box cars and gondolas, open-hearth steel axles for stock cars, Simplex bolsters for box cars, hopper-bottom gondolas and stock cars, American Steel Foundries' bolsters for drop-end gondolas, Winslow improved roofs for box cars, and Scott springs, arch-bar trucks, Miner dratt rigging, Harrison dust guards, McCord journal boxes and Patterson-Sargeant Co.'s paint for all.

BRIDGE BUILDING.

ALLENTOWN, PA.—Plans are being made by City Engineer Bascom for the proposed Tilghman street bridge, which is to be 900 ft. long and 60 ft. high on three solid masonry piers.

BUTTE CITY, CAL.—The steel drawbridge over the Sacramento River, owned by the county, was damaged to the extent of about $15,000 by collision of a steamer with its central pier.

CHARLOTTETOWN, P. E. I.—Q. B. McMillan, Secretary of the Department of Public Works, is receiving bids for building a steel bridge over the Morrell River.

CHATTANOOGA, TENN.—There were 13 bids opened March 10 for building the viaduct on McCallie avenue over the tracks of the Cincinnati Southern and the Western & Atlantic. The lowest was that of the Converse Bridge Co., of Chattanooga, who bid $68,000 on structure with a 40-ft. roadway, and $48,000 with a 30-ft. roadway.

CINCINNATI, OHIO.—The County Commissioners will build a new lift bridge at Benson street, Lockland, over the canal, at a cost of about $100,000.

COLUMBUS, OHIO.—The Auditor of Franklin County will receive bids April 7 for $60,000 of bonds for the Big Walnut Creek Bridge and $40,000 of bonds for the Allen Creek Bridge. L. E. Jones is County Auditor.

Bids are wanted April 12, by the Board of County Commissioners for some new bridges and repairs to others. L. E. Jones is clerk of the board.

DANVILLE, PA.—Viewers have been appointed by the Dauphin County Court for a new state bridge at Danville to replace the bridge destroyed by floods. The cost will be about $150,000.

DENVER, COLO.—Bids are wanted, April 8, by L. G. Carpenter, State Engineer, for building a steel bridge 100 ft. long with 16-ft. roadway on stone abutments over the Yampa River at Steam Boat Springs, Routt County.

Bids are also wanted on the same date by L. G. Carpenter, State Engineer, for building a steel bridge 64 ft. long with 16-ft. roadway on tubular piers over the middle fork of the South Platt River at Fairplay, Park County.

ELMIRA, N. Y.—An iron bridge will be built over the Chemung River. The Mayor can give information.

EVERETT, WASH.—The City Clerk has been instructed to ask bids for building a steel bridge over the Snohomish River, to cost about $65,000.

GALVESTON, TEXAS.—The Southern Pacific improvements include the building of a viaduct in West End, to cost about $60,000.

HARRISBURG, PA.—The Philadelphia & Reading will build overhead bridges at Hemlock and Cameron streets.

HOWARD, S. DAK.—Bids are wanted April 5, by Frank Smith, County Auditor, for building all the bridges for one year in the county of Miner, S. Dak.

KENOSHA, WIS.—The Bridge Committee has decided to build the Middle street bridge. It is to be of steel and concrete construction to cost about $12,000.

KEWANEE, WIS.—A new bridge will be built over the Kewanee River, for which bids will be asked as soon as negotiations are completed.

LAWTON, OKLA. T.—The Lawton, Wichita & Gulf R. R. has asked authority to build a bridge over Red River at a point on the boundary line of Lawton and Texas.

LEWISTON, PA.—The Lewiston & Reedsville Electric Ry Co. will build the steel superstructure of the Juniata river bridge at this place.

LOCKPORT, ILL.—A swing bridge over the channel is proposed to be built this summer at a cost of about $35,000.

MANILA, P. I.—Bids are wanted June 1, at the office of the Municipal Board, for building the superstructure of a lift bridge over the Binondo Canal.

MANSFIELD, OHIO.—Richland County Commissioners will issue bonds for about $30,000, to rebuild bridges recently destroyed by floods.

MINNEAPOLIS, MINN.—Bids are wanted, April 8, for building a bridge over the Mississippi River. Andrew Rinker is City Engineer.

MONTGOMERY, W. VA.—A company is reported being organized to build a $60,000 suspension bridge over the Kanawha River. Address H. D. Allen.

NEWARK, N. J.—Bids are wanted April 19 at the office of the Essex County Park Commission, 800 Broad street, for building two concrete-steel arch bridges; one at Park avenue, a span of 132 ft. and 74 ft. wide, and the other at Bloomfield avenue, a span of 70 ft. and 69.5 ft. wide, as advertised in the *Railroad Gazette*. A. Church is Secretary of the Essex County Park Commission.

NEW FANE, N. Y.—A petition has been presented by residents to the Town Board for a bridge at Burt, to be 400 ft. long and 65 ft. above low-water mark. A vote will soon be taken on the question of building this bridge.

NEWPORT, PA.—The Pennsylvania, reports say, has agreed to contribute $22,000 towards the cost of building an iron bridge over the Juniata River to replace the old wooden structure.

OTTAWA, ONT.—The Carleton County Council has decided to replace the iron bridge over Jock River near Richmond with a concrete bridge; the County Engineer at Ottawa has the plans.

PASSAIC, N. J.—The County Board of Freeholders has received notice from the War Department that the draws of bridges over the Passaic River must be widened. The Freeholders may soon ask bids for several bridges to carry out the directions of the War Department.

PIEDMONT, W. VA.—An interstate county bridge will be built between this place and Westernport, Md.

PORTSMOUTH JUNCTION, OHIO.—The Norfolk & Western is considering the question of rebuilding the present bridge over the Scioto River, on its Cincinnati Division, at Portsmouth Junction.

ST. PAUL, MINN.—The Northern Pacific has filed plans with the City Engineer for a new steel viaduct to connect Fourth street with the Sixth street bridge, to cost about $50,000.

ST. THOMAS, ONT.—A steel bridge with concrete abutments will be built in the township of Yarmouth.

SEATTLE, WASH.—The Northern Pacific has asked permission to build a bridge over the west channel of the Duwamish River, near West Seattle.

SKOWHEGAN, ME.—This town will build, during the year, a steel bridge about 234 ft. long over the south channel of the Kennebec River. Address the Skowhegan Bridge Committee.

STATE OF MEXICO, MEX.—An iron bridge will be built over the Canal del Desque to the town of San Joaquin. Senor Gen. Jose Vicente, Villada Toluca, can give information.

STILLWATER, OKLA. T.—Bids are wanted April 7 for building about 18 steel bridges in Payne County. A. J. Hartenbower is County Clerk.

SULLIVAN, IND.—Bids are wanted April 5, by the Board of Commissioners, for building seven steel bridges and repairs to two bridges. J. M. Lang, Auditor.

SUNBURY, PA.—The Northumberland Bridge Co. will replace with a steel structure the bridge recently washed away by floods.

SYRACUSE, N. Y.—A bill has been introduced in both houses of the State Legislature asking for an appropriation of $10,000 towards building a steel bridge over the Seneca River at Cold Springs. The towns of Salina and Lysander will each contribute $5,000 to complete the work.

THIEF RIVER FALLS, MINN.—The United States Senate on March 15 passed the bill authorizing the Minneapolis, St. Paul & Sault Ste. Marie Ry. to build a railroad bridge over Red Lake River, at Thief River Falls, Minn., the plans and construction of the bridge to be subject to the approval of the Chief of Engineers, United States Army, and the Secretary of War. (Feb. 26, p. 151.)

TERRE HAUTE, IND.—On March 16 a bill was introduced in both Houses of Congress authorizing the Commissioners of Vigo County, Ind., to build and maintain a combined wagon, foot and trolley car bridge over the Wabash River, at the foot of Wabash avenue, in Terre Haute.

TOPEKA, KAN.—Bids are wanted, April 4, for building a steel truss bridge on East Eighth avenue over Shunganunga Creek. J. H. Squires is City Clerk.

TWO RIVERS, WIS.—The Chicago & North Western will build a railroad bridge over Neshoto River at Adams street.

VANCOUVER, B. C.—Bids will be received by Alexander Phillip for building a steel bridge over the Capilano River. Also for one over the Seymour River.

WELLAND, ONT.—Application will be made to the Dominion Parliament for an act extending the time for the building of the bridge over Niagara River by the Welland & Grand Island Bridge Company.

WILLIAMSPORT, PA.—The County Commissioners have asked the state to rebuild the bridge recently destroyed at Picture Rocks. The cost will be about $17,000.

YORK, PA.—The County Commissioners have asked the state to rebuild the bridges washed away by recent floods at Yorkhaven and Wago and at the mouth of Codorus Creek. The cost will be about $30,000.

YOUNGSTOWN, OHIO.—Bids are wanted April 4, by the Board of Public Service, for repairing the East Central street bridge.

Other Structures.

ANDERSON, IND.—The Indiana Union Traction Co. will build a car repair shop to cost about $25,000, at North Anderson.

BIRMINGHAM, ALA.—The White-Blakeslee Manufacturing Co. will rebuild its engine works, recently destroyed by fire. A brick building will be put up 72 ft. x 128 ft., with 32 ft. span and center for electric frame. New machinery will also be added.

CHAUDIERE JUNCTION, QUE.—Bids are being asked for building a machine shop at Chaudiere Jct., Que., for the Intercolonial Ry.

ELIZABETH CITY, N. C.—The Suffolk & Carolina and the Norfolk & Southern railroads will build a union passenger station at this place.

EL PASO, TEXAS.—The El Paso & Northeastern, it is reported, will remove its shops from Alamogordo, N. Mex., to El Paso.

HATTIESBURG, MISS.—Plans are being made by the railroads for building a union passenger station.

INDIANAPOLIS, IND.—E. W. Spack Machine Co. has bought a plot of land north of its present building, on which it will build a steel frame machine shop with a frontage of 80 ft., extending from Madison avenue to Pennsylvania street. A new foundry is to be built later on.

JACKSON, MISS.—The Illinois Central has offered to spend $30,000 in rebuilding the old passenger station, but it may build a new one.

LOUISVILLE, KY.—The Louisville & Southern Indiana Traction Co. has bought land on which it will build brick car barns.

NEW YORK, N. Y.—Plans have been filed with the Bureau of Buildings by the Interborough Rapid Transit Company for a new power house of two stories, 103 ft. x 58 ft., of brick and stone, to be built on the east side of Hillsdale avenue, south of Eleventh avenue, to cost about $100,000.

TERRE HAUTE, IND.—The Chicago Tie Preserving Co. will soon begin work on a branch plant at this place.

WEST MILWAUKEE, WIS.—The Chicago, Milwaukee & St. Paul, reports say, will build a new 24-stall roundhouse of brick and steel, to cost about $30,000.

RAILROAD CONSTRUCTION.

New Incorporations, Surveys, Etc.

AUGUSTA & ELBERTON.—It is reported that this company will soon begin work on its proposed line from Augusta, Ga., to Elberton, 60 miles. F. T. Lockhart and C. B. Young, of Augusta, are reported to be interested.

BALTIMORE & OHIO.—Surveys are reported in progress in the vicinity of Warfordsburg, Pa., four miles north of Hancock, Md., to locate a favorable grade from Deneen's Gap to the Potomac River at Hancock. The survey is a part of the plan to straighten the line and ease the grades for through traffic to and from Pittsburg, and particularly to do away with the heavy Sand Patch grade.

BALTIMORE & SOUTHWESTERN.—Application has been made to the Maryland Legislature for a charter to build a proposed railroad from Baltimore along the western shore of Chesapeake Bay to a point south of Annapolis, where connection will be made with the eastern shore by means of a ferry. It is proposed also to extend the road to the Virginia state line and eventually to Norfolk, Va. F. E. Waters, R. B. Dixon and A. P. Gorman, Jr., are incorporators.

BEE TREE.—Incorporation has been granted this company in North Carolina. It is proposed to build a line from Swannanoa, N. C., on the Southern, to Craggy Mountain, eight miles. Bids will be asked in about a week. J. J. Dalton will be in charge of the work.

BINGHAMTON & SOUTHERN.—It is reported that this company is about to let contracts for building its line from Binghamton, N. Y., southwest to Williamsport, Pa., 130 miles. A. K. Harvey, Binghamton, N. Y., will have charge of the work, and it is stated that grading will be begun at once. (See Construction Supplement.)

BOUNDARY, KAMLOOPS & CARIBOO CENTRAL.—Press reports state that application is now being made to the Dominion Parliament for the incorporation of this company. It is proposed to build a railroad from Midway, B. C., northwest to Okanogan Lake and thence north via Kamloops to a terminus in Yukon Territory.

CHICAGO, JOLIET & IOWA.—Rights of way have been nearly all secured for this proposed road from Chicago to Monmouth, Ill., 170 miles. It is stated that contracts for grading have been let for the section between Joliet and Sheridan. B. F. Hardesty, Newark, Ill., may be addressed. (See Construction Supplement.)

DELAWARE & HUDSON.—It is reported that this company intends to build a branch from Granville, N. Y., to the southeast of Lake St. Catherine in Vermont. No surveys have as yet been made.

DETROIT & MACKINAC.—Surveys will be begun at once for an extension of this road from Cheboygan, Mich., north to Mackinac, 17 miles. (See Construction Supplement.)

ELMIRA & CORNING SHORT LINE.—This company has been incorporated in New York to build an electric railroad from Elmira to Corning, 13 miles. J. H. Caldwell, W. F. Hurley, Troy; W. J. Tully, Corning; L. S. Manley, Elmira, N. Y., and others are incorporators.

FORT WAYNE & SOUTHWESTERN.—Press reports state that rights of way are now being secured for this proposed road from Indianapolis, Ind., northwest to Fort Wayne, 95 miles. A mortgage for $2,000,000 has been filed with the Marion Trust Co., of Indianapolis. It is reported that work will soon be begun.

GULF & NORTHWESTERN.—Rights of way have been secured for this proposed road from Waco, Texas, via Stephensville, to Thurber, 100 miles. Surveys will be begun at once and contracts for grading will be let as soon as the surveys are completed. The work will include one large wooden trestle and the removal of about 1,250,000 cu. yds. of earth. It is stated that the company will soon be in the market for rails, spikes, bolts, switches, frogs and ties. P. A. McCarthy, Waco, Texas, is Vice-President and General Manager.

ILLINOIS CENTRAL.—An officer writes that the following work is being done by this company: Grade reduction on 100 miles of main line between Waterloo and Fort Dodge, Iowa, on which work will be completed soon; MacArthur Bros., contractors. New loop, 6½ miles long, west of Cedar Falls, Iowa, avoiding heavy grade on the present main line. To be completed this spring; Lorimer, Gallagher & Walsh, Contractors. Grade reductions between Belleville and Pinckneyville, Ill., 47 miles, reducing the present maximum grade from 40 ft. per mile to 26 ft. per mile; work practically completed. Cut-off from Groves Station, near the south line of Perry County, to Sand Ridge, in Jackson County, 17 miles. This line will shorten the present route via Murphysboro about seven miles and will give the line grades not exceeding .5 of one per cent. Work will be completed this spring. On 122 miles of the second track on the main line between Fulton and Memphis, Tenn., the following sections have been completed: Fulton to Paducah Junction, 11 miles; Trimble to Dyersburg, 18 miles; curve to Atoka, 32 miles, and Millington to Woodstock, eight miles.

INTERNATIONAL OF NEW BRUNSWICK.—It is stated that work will be begun May 1 on this line, which is projected from Campbellton, N. B., to St. Leonards. T. Malcolm has the contract for grading. The road was originally chartered as the Restigouche & Western and about six miles of track were laid in 1903.

MEXICAN CENTRAL.—It is reported that this company will soon resume work on its Cuernavaca Division, which was formerly the Mexico, Cuernavaca & Pacific. This road was purchased by the Mexican Central in 1902 and runs from the City of Mexico to Balsas, about 300 miles. It is proposed to extend the line to the Port of Acapulco, on the Pacific coast of Mexico.

MISSOURI PACIFIC.—The report of this company for the year ending Dec. 31, 1903, gives the following statement of work now in progress: Line from McGehee to Latour, Ark., 81 miles, grading about 80 per cent. completed. Line from Cotter to Aurora, 107 miles, grading about 60 per cent. completed. Line from Aurora to Carthage, 38 miles, grading completed and track laying in progress. This work includes five tunnels, which are about half completed. Extension from Felsenthal to Union Parish, La., 28 miles. Five miles completed and grading in progress on about half of the remaining distance. Fort Smith branch, six miles long, around the city of Fort Smith, Ark. Grading well under way and track laying to be begun at once.

MONTANA NORTHERN.—Articles of incorporation have been filed by this company in Montana. It is proposed to build a line from Basin to Elliston, 25 miles. Connection will be made with both the Northern Pacific and the Great Northern at Elliston. M. L. Hewitt, C. C. Darrow, E. W. Burdick and others, of Boulder, Mont., are incorporators.

NASHVILLE, CHATTANOOGA & ST. LOUIS.—This company has bought 42 acres of land five miles north of Atlanta, Ga., for a new yard. A contract is reported let to the Southern Contracting Co., for the grading.

NEPIGON.—Application is being made at the present session of the Dominion Parliament for power to extend this company's line from the Albany River to Fort Churchill. The line is now projected from Nepigon Bay, on Lake Superior, to Nepigon Lake, 40 miles. Conmee & Bowman, Port Arthur, Ont., have the general contract for building.

NEW BRUNSWICK R. R.—Application is being made at the current session of the New Brunswick Legislature for an act incorporating this company, with power to build from Hampton, N. B., southwest to St. John and thence north to Gagetown, 50 miles. J. S. Armstrong, St. John, N. B., may be addressed.

NICHOLS & NORTH PENNSYLVANIA.—A charter has been granted this company in New York to build a steam railroad three miles long from Nichols, Tioga County, to the Pennsylvania State line.

OKLAHOMA ELECTRIC.—A charter has been granted this company in Oklahoma to build an electric railroad from Oklahoma City southeast through the counties of Oklahoma and Cleveland to Sulphur Springs, Ind. T. R. E. Thatcher, E. P. Moseley, Jay Sherman and others, of Lexington, Okla. T., are incorporators.

OREGON R. R. & NAVIGATION CO.—It is reported that a contract for building an extension of this road from Riparia, Wash., northwest along the Snake River to Lewiston, Idaho, 60 miles, will be let very shortly and that grading will be begun as soon as the weather permits. (See Construction Supplement.)

PEARSONS & BALTIMORE.—A bill has been introduced in the Maryland Legislature to incorporate this company to build a railroad from Pearsons, in St. Mary's County, Md., north to Baltimore, about 90 miles. C. L. Applegarth, S. A. Foutz, H. P. Pearsons, W. H. McGee and others, of Baltimore, are incorporators.

PIEDMONT ELECTRIC.—A charter has been granted this company in Georgia. It is proposed to build an electric railroad from Atlanta, Ga., through Roswell and Alpharetta to Cumming, 23 miles. J. A. Tyler, C. R. Maddox and others, of Atlanta, are incorporators.

ST. FRANCOIS COUNTY.—A charter has been granted this company in Missouri. The new company, will absorb the St. Francois County Electric Ry. Co., and will complete the line from Delassus through Farmington to Flat River, 12 miles. C. H. Bosworth is President and W. J. Cook Secretary, both of Farmington, Mo.

ST. LOUIS, LITTLE ROCK & NORTHERN.—Articles of incorporation have been filed by this company in Arkansas to build a railroad from Little Rock through the States of Missouri, Arkansas, Louisiana and Texas to Sabine Lake on the gulf, a total distance of about 700 miles. W. E. Thomas, A. L. Hale and others, of Little Rock, Ark., are incorporators.

ST. LOUIS & SAN FRANCISCO.—Press reports state that this company has let a contract to Johnson Bros. & Faught, of Oklahoma City, for building the extension of its Guthrie branch from Chandler, Okla. T., to Okmulgee, Ind. T., connecting at the latter point with the Ozark & Cherokee Central. J. F. Hinckley, St. Louis, Mo., is the Chief Engineer.

SOUTHERN PACIFIC.—Press reports state that seven bids ranging from $2,000,000 to $2,500,000 have been received by this company for the grading and tunnel work on the Bay Shore cut-off. This line will extend from Third and Townsend streets, San Francisco, south along the bay to San Bruno, 11 miles. The work will include five tunnels through the Petrero Hills. The contract will be awarded within 30 days. (See Construction Supplement.)

TEXAS, SABINE VALLEY & NORTHWESTERN.—Press reports state that surveys are in progress for two branch lines, one north from Longview, Tex., to a connection with the Texas Southern, near Marshall, and the other southeast from Timpson to a connection with the Atchison, Topeka & Santa Fe. The proposed northern extension will be 17 miles long and the southern 38 miles long. It is stated that work will soon be begun. (See Construction Supplement.)

TOMBIGBEE & NORTHERN.—A contract for changing the entire rolling stock of this road from narrow gage to standard gage is reported to have been let to the Peacock Iron Works, Selma, Ala. The road is 35 miles long and runs from Tombigbee River to Turners, Ala. The chief offices of the company are at Mobile.

TONOPAH.—Grading has been completed on this road for a distance of 35 miles and track laying will soon be begun. The proposed route is from Rhodes, Nev., to Tonapah, 63 miles. McClain & McSweeney are the contractors. Paul Inglehart, Tonopah, Nev., is Chief Engineer. (See Construction Supplement.)

WABASH.—It is reported that this company will soon let contracts for building its Greene County line from Pittsburg to Bellington, W. Va. Surveys for this line were completed last year and rights of way have now been secured. J. W. Patterson, Jr., Pittsburg, Pa., is in charge of the work. (See Construction Supplement.)

WESTERN MARYLAND (WABASH).—This company has practically completed its tidewater extension in Baltimore. Track has been laid from Walbrook station down Gwynn's Falls to Spring Garden, and thence over the Patapsco River to Winans Cove, about six miles. (See Construction Supplement.)

GENERAL RAILROAD NEWS.

CANADIAN ROADS.—Railroad subsidies to the amount of $1,463,000 were paid out by the Dominion Government during 1903. The principal recipients were the Canadian Pacific (for western branches), $199,000; Algoma Central & Hudson Bay, $203,000; Atlantic & Northwestern, $186,600; Quebec Bridge, $132,000; Midland, $190,186; Canadian Northern, $57,485, and the Crows' Nest, $60,000.

CHICAGO, ROCK ISLAND & PACIFIC.—At a meeting of the stockholders of this company at Davenport, Iowa, on March 21, a vote was taken in favor of a bond issue for $163,000,000. The plan, as ratified, calls for the immediate issuing of $15,000,000 first mortgage, 4 per cent. gold bonds to fund advances which have been made to subsidiary companies. The stockholders also indorsed the lease of the Choctaw, Oklahoma & Gulf and the purchase of the following lines: Minneapolis & St. Paul Terminal; Choctaw, Oklahoma & Western; Searcy & Des Arc, and the Hazen & Northern.

CLEVELAND & PITTSBURG.—A circular has been sent to the stockholders of this company calling for a special meeting on May 19 to authorize an increase in the capital stock of $10,738,134. The stock now outstanding amounts to $11,261,866, and a 7 per cent. dividend is guaranteed on the stock by the Pennsylvania Railroad Co. It is stated that the new shares, which are to reimburse the Pennsylvania for money loaned for improvements will bear a guaranteed dividend of 4 per cent. The Cleveland & Pittsburg's lines aggregate 227 miles of road, being an important part of the Pennsylvania's North West System.

METROPOLITAN STREET RAILWAY (NEW YORK).—At a recent meeting of the stockholders of this company it was voted to lease the property of the Central Crosstown R. R. for a term of 999 years and to guarantee the principal and interest on its bonds and the payment of a rental equal to 15 per cent. per annum, on its $600,000 of outstanding stock. The Crosstown R. R. will issue a first consolidated mortgage for $3,000,000 to provide for equipping the road with electricity. The Metropolitan owns $499,000 of the stock, on which 10 per cent. has heretofore been paid.

MEXICAN LIGHT & POWER CO.—It is reported that this company is about to acquire the Federal District Street Railway System of the City of Mexico, which is owned by London capitalists. The proposed consideration to be paid for the electric system is said to be about $18,000,000.

MISSISSIPPI, ARKANSAS & WESTERN.—This company has filed a mortgage with the City Trust Co., of New York, to secure an issue of $1,500,000 of bonds. The proceeds will be used to pay for an extension from the present terminus west to Camden, Ark., 65 miles.

MISSISSIPPI CENTRAL.—This is the new name of the Pearl & Leaf River. All accounts and bills contracted prior to March 15, 1904, should be rendered against the Mississippi Central. M. H. McCabe, Hattiesburg, Miss., is Superintendent.

NORTHERN SECURITIES CO.—At a meeting of the directors of the Northern Securities Co., on March 23, it was voted to return to stockholders 99 per cent. of their holdings; this representing the Great Northern and Northern Pacific stocks held by the N. S. Co. The G. N. and N. P. stock will be distributed on a pro-rata basis. In exchange for 99 per cent. of each hundred shares of the $395,400,000 capital stock of the Securities Company stockholders will be given 39.27 shares of Northern Pacific stock and 30.17 shares of Great Northern stock. A circular has been issued to the stockholders calling a meeting on April 21 to ratify this plan, which has been made to comply with the recent decree of the Supreme Court. The circular says, in part: The company's acquisition of Northern Pacific and Great Northern shares was made in the belief that such purchases were in no wise obnoxious to any law of the United States. However, a majority of the Supreme Court of the United States has handed down the opinion that as a matter of law your company's holding of the stocks of the two railroad companies in itself constituted a restraint of interstate commerce prohibited by the so-called Sherman act of 1890. Accordingly the railroad companies have been forbidden to permit your company to vote or collect dividends on the shares held by it. Therefore your directors have, under the advice of counsel, decided that it is necessary to reduce the capital stock of the company, and to distribute to its shareholders the shares of stock of said railroad companies now held by it. The assets of the company remaining in its treasury after the foregoing distribution is made, will consist of stocks and other property in no way involved in the suit, producing income, and conservatively valued at an amount in excess of the $3,954,000 to which it is proposed to reduce the stock of the company.

PEARL & LEAF RIVER.—See Mississippi Central, above.

QUEBEC SOUTHERN.—Judge Burbidge, Montreal, has announced his decision to appoint a receiver for this road. It is stated that the register of the Exchequer Court will be appointed receiver and that the road will be operated by the Intercolonial under contract until arrangements can be made for its sale.

TENNESSEE CENTRAL.—The Chancery Court of Roane County at Kingston, Tenn., has appointed W. J. Oliver, of Knoxville, receiver of this company, upon application of M. N. Elkan & Co., of South Carolina, sub-contractors, for a claim of $44,000.

WABASH.—At a special meeting of the stockholders of this company, at Toledo, on March 22, it was voted to authorize an increase of $50,000,000 in the company's capital stock. This action was taken to comply with the law of Missouri under which the Wabash is incorporated. Under this law, the company is not allowed to have a bonded indebtedness which is larger than its capital stock. The bonded indebtedness of the company has exceeded its capital by $43,000,000, but the increase voted will bring the capital stock up to $102,000,000, or about $7,000,000 more than the bonded debt.